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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

Third Annual Meeting of the Central Gas Engineers Association.

The Third Annual Meeting of the Central Gas Engineers Association will be held at the Vanderbilt House, Syracuse, New York, on Wednesday, May 17th, 1882. It being the occasion of the election of officers, it is trusted there will be a full attendance of the members. Members are earnestly requested to prepare papers to be read at this meeting, that it may be one of great interest.

C. A. WHITE, *Secretary.* A. C. WOOD, *President.*

[OFFICIAL NOTICE.]

The Western Gas Association

SECY'S OFFICE, WESTERN GAS ASSOCIATION,
110 VINE ST., ST. LOUIS, MO., Feb. 21, 1882.

The Fifth Annual Meeting of the Western Gas Association will be held at the Grand Pacific Hotel, Chicago, Ills., on the 10th, 11th and 12th days of May, 1882. A full attendance is requested, as matters of great interest will be presented at the Meeting.

LEE A. HALL, *Secretary.* THOS. BUTTERWORTH, *President.*

THE AMERICAN ELECTRIC LIGHT COMPANY OF BOSTON.

A company, said to be organized under the laws of the State of Massachusetts, with the above name, has, according to the Boston papers, come to grief, and seems to be left in a wrecked condition with $15,000 debts and no assets, except "rights and stock."

The affairs of this company seemed to be decidedly mixed between parties from New York and parties from Boston, and it is needless to attempt to unravel its mysteries for the benefit of our readers. Highly respectable names cannot, of themselves, save any concern.

To those proposing to invest in electric lighting schemes it might be suggested that the business of lighting by electricity is a legitimate business, when carried on in a legitimate way, and is entitled to respect; but when the popular cry of "lighting by electricity" is employed to promote schemes for floating stock, selling rights, and otherwise doing a kite-flying business, it becomes another matter, and it is a pity that the beauty of the pure electric arc, or incandescent loop, should be marred by having its name used for improper purposes. But how can it be expected that electric lighting should escape any more than gas lighting—for has not the good old-fashioned business of gas lighting had to endure the tribulation of having many a scheme, promoted under its name, which had no other basis than patents for processes which, somehow or other, could never be made to work with satisfaction and profit after their removal from the nursery where they were born.

With many of these patents there were "millions it it" before they were tried. So it is with other branches of business. If a company is organized to sell electric light on a business basis, and can get plenty of business at prices that will pay a profit, there is no reason why any one should not invest in it, if he has the money, and feels disposed to use it in that way. But there is no royal road to wealth in the lighting business, whether by oil, or by gas, or by electricity. Concerns that are properly conducted, and sell a good article at remunerative prices, usually pay; but money cannot legitimately be made out of nothing. Stocks may be worked and manipulated for a while, but some one gets hurt in the end.

To those who propose to invest in electric light we would say, invest in a business and not in a scheme.

The whole business is very well covered with patents, and a strong and powerful combination has been made for the purpose of defending the essential patents from all infringement. It would seem from this that those who are disposed to do a legitimate business, in a legitimate way, have become fully convinced of the danger inherent in a multiplicity of interests working for the same business, and the wisdom of consolidation must appear if there is any truth in the old motto, "in union there is strength." Of course there is a great advantage in mutual protection; how much money value this advantage is worth remains to be seen.

The New York *World*, of April 28th, publishes the following—

"An important movement in electric lighting was consummated yesterday at the election of the representatives of the different companies to the new "pool-board." For some time the so-called Gramme Company has been composed of the United States, the American, of New Britain, Conn.; the Brush, the Fuller, the Jablochkoff and the Weston. On Tuesday last, arrangements were completed under which the Edison joined the combination. The following gentlemen were yesterday elected as representatives: G. W. Hibbard from the United States; G. W. Stockley from the Brush; Leon-

ard E. Curtis from the Weston ; Wm. M. Jones from the Jablochkoff ; S. B. Eaton from the Edison ; Wm. Parker from the American ; and Wm. H. Appleton from the Fuller. Besides these there are in the Board of Trustees Roland Hazard, the newly elected President, and H. J. Hoyt, the vice-President. The Secretary is R. W. Blackwell. In addition to the Board of Trustees there will be an advisory board, to consist of fourteen members, two from each company. The objects of the pool are to equalize prices, substitute arbitration for litigation between the companies, and to prosecute all companies which may infringe upon any of the patents now owned by the members of the pool.

"There are 228 of these granted from 1865 to the present year, and as it is impossible for any man to make use of electric lighting without infringing some of them the combination practically controls this important business. The Gramme company proper owns the first patents issued for electric lighting, and all of the members of the pool are to pay it five per cent. royalty on the selling price of machinery manufactured by them. For some time past there have been a number of companies organized for the ostensible purpose of lighting with electricity. Owning no patents, and without means to carry on the business, they have swindled a large number of people by selling stock. The new pool will prosecute such companies and drive them out of the business. For such purposes there is to be a common fund contributed by all the members of the pool. The prices at which lights will be furnished will be regulated by the advisory board.

"The companies composing the pool, however, are no less independent than before. They will continue in business separately and each will endeavor to get as much business for itself as it may. The formation of the pool, however, will permit of much more attention being paid to legitimate business, as it is hoped the arrangements for referring matters in dispute to an arbitration committee will do away with the necessity of law suits. At the conference between the representatives of the companies the question of how to gain public confidence in a responsible system of electric lighting was fully discussed, and measures will be taken to draw the attention of the public to this method of furnishing the light."

As to the profitableness of the lighting business there may be some question thus far. The Brush Company, in New York, have just raised their price to the city from 33 to 70 cents per lamp, and for lights at the High Bridge proposed to charge $1 per lamp, if the city furnished steam, and $1.50 if the company furnished it. In London the first year's contracts with the Brush, Lontin and Siemens systems have just expired, the cost of which to the city (lighting from sunset to sunrise) has been as follows :

Brush.....	38	lamps at	$3,300	replacing	156	gas lights, at $3,450
Lontin.....	32	"	7,300	"	157	" 3,500
Siemens....	34	"	11,350	"	139	" 3,060
Total.....	99		$21,950		452	$10,010

Cost of electric plant not included in the above.

There is no doubt ample field for the electric light ; but, if interest is to be paid on the capital put into legitimate companies, good round prices must be charged. Even at the above prices the London companies are not satisfied, and ask to have their prices advanced from 10 to 30 per cent.

Electricity and Gas.

The question as to which of these two illuminating agents is the more economical for the purposes of lighting our streets is just now receiving a considerable amount of attention. Both have able advocates but those in favor of gas have certainly the most exhaustive data to base their arguments upon ; and we may generally consider the figures given by well-known engineers connected with our gas companies as reliable, so far as street lighting by the ordinary burners which are generally employed is concerned. But with new and improved burners, especially those giving a high illuminating power, the figures given by observers differ as we shall presently show. A correspondent writing to us last week gave the following results regarding the Siemens regenerative gas burner, which is now employed for lighting that part of Holborn from the Circue to Gray's Inn Road. In a certain size of burner, the consumption of 30 ft. of gas per hour gives, it is said, a flame of 120 candles ; whilst a larger one, consuming 100 feet per hour, yields a light of 1,000 candles. It will be seen form this, that with a little more than three times the amount of gas consumed, wet get an increase in illuminating power of eight times approximately ; or if we consider it from another point of view, and divide the 100 cubic feet of gas amongst a cluster of three of the burners constructed to consume 30 feet per hour each, we get a light of—say, 400 candles ; and by utilizing this volume of gas in a single burner of the large size, we increase our light 2½ times. Our contemporary, the *Engineer*, however, gives a less satisfactory result concerning this same system of gas lighting :

"In Holborn twenty-four lamps have been erected, the consumption of which ranges between 22 ft. and 24 ft. of gas per hour, with an average illuminating power per lamp of 130 candles. In addition to these Messrs. Siemens have fixed two large lamps, one at either end of the Holborn Viaduct, each of which, burning 65 ft. of gas an hour, gives a light equal to 400 candles."

Here it appears that three times the consumption of gas gives only thrice the amount of light, although it must not be forgotten that these burners, as compared with the best of the ordinary street gas jets give, according to these figures, about 70 per cent. more light for the same consumption of gas.

Now turning to the electric light, the following extract from the report of the meeting of the Court of Common Council, held on the 30th March, will be of great interest to both parties, and will probably create feelings in each of a different nature :

"At the meeting of the Court of Common Council, Mr. Felton, Chairman of the Curt of Sewers, stated that the three electric lighting systems now being tried experimentally in the city, that of the Brush was about the same price as gas, the Lontin (?) was twice the cost, and the Siemens nearly four times the cost. The Brush patentees had given notice to increase their contract price 10 per cent., and the Siemens authorities also contemplated increasing their estimate to five times the cost of gas in the same area. As to the new effective gas lighting in Fleet street, he mighe state that it was over four times the cost of the Brush system in the same district."

Although the gas companies have doubtless accurate figures to rely upon, we cannot say so much for those interested in the introduction of the electric light into our streets. We believe the amount paid for lighting the district occupied by the Brush system was, last year, £30 cheaper than had been previously paid for gas. It is difficult to imagine that the Anglo-American Brush Electric Light Corporation were not working at a loss, and the same remark applies to their present estimate, 10 per cent. over that of last year. We say this because it appears evident that Messrs. Siemens feel convinced that their contract, although at a price four times higher than that of gas, is not a profitable one to them, and that to continue the city lighting satisfactorily to themselves they wished to increase their estimate still further. However, in any case, the competing systems have not been compared in the way which would be most suitable for arriving at a definite conclusion concerning the comparative economy of gas *versus* electric light. We believe that Mr. Preece was amongst the first to advocate the test of each system lighting up a certain defined area to a *given standard of illumination*, and this we think is the only good test which has yet been proposed. What we require is that both systems shall have the same area to illuminate, and with the same number of lights, each of equal power, and then to compare the respective costs. It is very noticeable what a general degree of illumination is obtained on all portions of the pavements and road in Holborn, and the degrees of intense brightness and comparative shade are equally noticeable in Cheapside and Ludgate Hill. As a matter of fact we have till recent years tolerated street lamps of 15 candle power at the maximum, and now in the last-mentioned streets we jump up to lamps of 2,000 (?) candles each. Certainly they are more limited in number, but then the illumination is not general. Taking Holborn as a fair example of first-class general lighting by arranging lamps at certain distances apart, and each one giving a light of 120 to 150 candle power, whether obtained by means of gas or of electricity ; then we think that at this candle power electric lighting by incandescence would have the advantage over gas for the following reasons. To get such an amount of light from gas, we burn, say from 25 to 30 cubic feet per hour ; now this amount of gas, utilized in a gas engine, would furnish us about 1½ horse power. Such a motive force would produce even in incandescent electric lamps of 15 candles each a total light of about 220 candle power, but if the above horse power were utilized in working a smaller number of incandescent lamps up to a higher candle power, then our total light would be greatly increased. There is a certain point of illumination which we shall shortly hope to show, where the economy of gas and the electric light is identical, and on one side of this, that of the higher candle power, it will be found more advantageous to employ the electric light, but for a lower standard of light it will be more economical to use gas. As the light produced by ordinary gas burners when multiplied is apparently proportional to the amount of gas consumed, whilst the degree of illumination from the electric light increases in a much greater proportion than the amount of current passing, it follows that for large lights—say, of 150 candle power and upwards, the latter will be found cheaper ; but as we can divide up a given volume of gas into a number of small jets without any appreciable loss, whereas division in the electric light entails great waste, gas will have the priority for low standards of light. Therefore, the best conditions for lighting our streets economically by means of gas so as to diffuse the light generally would be to employ double the number of lamps we have at present in *ordinary* use. Our remarks referring to large lights are corroborated by the last sentence of the paragraph we have quoted relative to the lighting of Fleet street, and they apply still more strongly to the Siemens regenerative burner as used in Holborn.—*The Telegraphic Journal and Electrical Review.*

The Society of Gas Lighting.—The Relation of Different Retort Settings to Retort House Area.

The Society of Gas Lighting held its regular monthly meeting on Thursday, April 20, at the Eighteenth Street Station of the Manhattan Works.

A report of a committee appointed to investigate the facts regarding discrepancies between amounts of coal called for by bills of lading and the amounts as actually weighed out was made, and the committee continued.

The following resolutions, upon the death of Mr. George Dwight, having been passed at a previous meeting, they were ordered to be printed in the AMERICAN GAS LIGHT JOURNAL:

The committee appointed at the last meeting of the Society of Gas Lighting to prepare resolutions upon the death of our late Associate, George Dwight, respectfully offer the following:

Resolved, That the members of the Society of Gas Lighting have been witnesses of the cheerful disposition, the charitable impulses, and the high moral standing always maintained by our deceased friend and fellow member, George Dwight.

Resolved, That we were observers of his faithful service in his business, the earnestness of his purpose, and the desire to be first in the practice of his profession, as an able and intelligent engineer. Of ripe years, and having faithfully discharged the many trusts committed to his care with the dignity of a Christian gentleman, he now rests from his labors, leaving the impress of his character upon the various institutions with which he has been connected, and also a name to which his family and friends may always point as an example to be imitated by all those who may come after him.

Resolved, That the Secretary be directed to inform the family of our deceased friend of the action of this Society.

(Signed) JAMES H. ARMINGTON,
F. C. SHERMAN,
C. H. NETTLETON,
Committee.

The Society witnessed the operations of the steam stoking machinery and the mechanical appliances for handling coal, which are very complete. The labor saving resulting from these improvements was fully demonstrated by the practical operations witnessed.

The following paper, by G. Warren Dresser, was read and discussed:

THE RELATION OF DIFFERENT RETORT SETTINGS TO RETORT HOUSE AREA.

The introduction of furnaces upon some regenerative plan, and also the application of machinery, assisted by railroads and elevators, to the handling of coal and to the drawing and charging of retorts, is bound to change the working conditions under which our retort houses are managed to such an extent that it may not be uninteresting to investigate the relative capacity of various sized retorts arranged in various settings.

Much has been said and written about the relative production "per bench;" but this is a term so indefinite that by itself it conveys but little information. The size of the retorts, the number in the bench, and the amount of floor space covered are all important items. For the purposes of this paper certain things are assumed, and an effort is made to reduce the results attainable under the assumed conditions to one standard of comparison, and the FOOT FRONT OF BENCH is the standard selected.

All other things being equal, the relative amount of coal that retorts can carbonize depends upon the area of the bottom of the retorts, and the amounts carbonized in different benches depend upon the number of retorts. If we represent by A the number of square feet on the bottom of any retort, and by N the number of retorts in any bench, then the square feet of retort floor surface in any bench will be represented by AN. Now, if we represent by L the number of lineal feet in the front of any bench, measuring from center to center of piers, the expression AN ÷ L will give us the number of square feet of retort floor surface per "foot front of bench." Having this, the calculation can easily be extended either to square feet of ground covered by the benches, or the ground surface covered by the retort house, or in fact to almost any other reasonable unit of camparison.

First as to the retort floor surface, by which is meant the area of the bottom of the retorts. This discussion is confined to retorts of four different widths, viz., 20 in., 22 in., 24 in., and 26 in.; and for convenience of calculation the length of retort is taken at 10 feet. This gives us the following areas for the bottoms of the four different sizes, viz.:

20 in. × 120 in. = 16.66 square feet.
22 in. × 120 in. = 18.33 "
24 in. × 120 in. = 20.00 "
26 in. × 120 in. = 21.66 "

Secondly, the spaces around the retorts for the circulation of the combustion gases from the furnace from which the retorts are heated. We are fully aware that a wide difference of opinion exists as to the amount of this space absolutely necessary; and even when there is an agreement on this point, incidental considerations—such as the adjustment of standpipes and mouthpieces—cause variations within certain limits to be made in the distribution of these spaces. But it must be admitted by all, it is believed, that a space of four inches all round each retort is ample; and where the attendant circumstances require it, the division of this space among the different retorts may vary, provided a total of circulating space for the heating gases is preserved equal in amount to what would exist if we had four inches all round each retort. One thing is to be especially observed and borne in mind—to wit, that the ordinary wide space existing over the old-fashioned furnace fire can be much reduced, and the retorts arranged simply with reference to the circulation of the *gaseous fuel* which is supplied by the regenerative furnace, and which should come in at the base of the oven and be distributed as uniformly as possible along the length of the bench, rising up the central portion and passing down along the outer side walls. Adopting this four inch rule, we should have a space of four inches between the side walls and the adjacent retorts, and spaces of eight inches between the retorts themselves, measured in a horizontal direction.

Thickness of Retorts.—This, as is customary in clay retorts as now made, is 3 inches for ordinary sizes. This is ample where material and workmanship are both good for sizes up to 24 inches; but when the width is increased beyond that point it is not fair, either to the retort maker or to the repairs and maintenance account, to use less than 4 inches in thickness. Hence, for the 20 in., 22 in., and 24 in. retorts the thickness is taken at 3 inches, and for the 26 in. retorts it is assumed at 4 inches. Individual opinions may differ on this point, but in case it should be deemed prudent or practicable to deviate from this, and reduce all retorts to 3 inches thickness, the result would simply be to reduce the estimated width necessary for benches of 26 inch retorts by 2 inches, for each retort set parallel with the floor in any horizontal line.

Thickness of Piers.—I do not hesitate to assert that the American practice in this regard has been to build piers too thin; and as we are to consider the subject of benches with a view to increasing, if possible, the weight of coal carbonized per "foot front of bench," it must be borne in mind that this increased weight, not only of retorts, but of their contents, must be provided with adequate support, and the piers are the ultimate support of the structure and the contents thereof. Moreover, the benches will heat more uniformly with thick walls.

The Continental practice may be excessive in this respect, but I doubt it; there are many advantages and facilities which result from the thick, solid piers which may be seen in the plans of the most modern of European works. Here as elsewhere opinions may differ; but for the purpose of fixing the data of comparison I have assumed the thickness of piers to be established as follows:

For arches of 7 feet span or under (2 bricks).....18 inches.
For arches of from 7 feet to 10 feet 6 inches (2½ bricks)..24 inches.
For arches of from 10 feet 6 inches to 14 feet (3 bricks)..28 inches.

I have preferred to assume these different arbitrary dimensions, and from them determine the necessary width of arches for the arrangement of the different settings, as it brings everything to the same basis in a more satisfactory way, and does not necessitate the changing of any of the conditions of arrangement, so far as space is concerned, for the purpose of working in arrangements not originally contemplated. But it is perfectly easy for any one to make those changes which expediency may dictate, it is hoped, more intelligently after a study of the results obtained from our assumed basis of calculation.

Arrangement of Retorts in the Bench.—It is proposed to consider three systems of retort arrangement, as follows:

First, where we have 2 vertical rows of retorts in an arch;
Second, where we have 3 vertical rows of retors in an arch;
Third, where we have 4 vertical rows of retorts in an arch.

The first arrangement is the one in ordinary use in our settings of sixes; and taking the dimensions, spaces, and thickness of retorts already assumed, we shall have—

For 22 in. retorts, an arch 6 ft. 0 in. wide, pier 1 ft. 6 in. = 7 ft. 6 in. front
" 24 in. " " 6 ft. 4 in. " " 1 ft. 6 in. = 7 ft. 10 in. "
" 26 in. " " 7 ft. 0 in. " " 1 ft. 6 in. = 8 ft. 6 in. "

Similarly for the second arrangement we have—

For 20 in. retorts, an arch 8 ft. 6 in. wide, pier 2 ft. = 10 ft. 6 in. front.
" 22 in. " " 9 ft. 0 in. " " 2 ft. = 11 ft. 0 in. "
" 24 in. " " 9 ft. 6 in. " " 2 ft. = 11 ft. 6 in. "
" 26 in. " " 10 ft. 6 in. " " 2 ft. = 12 ft. 6 in. "

For the third arrangement (4 vertical rows) we have—

For 20 in. retorts, an arch 11 ft. 4 in. wide, pier 2 ft. 4 in. = 13 ft. 8 in. front
" 22 in. " " 12 ft. 0 in. " " 2 ft. 4 in. = 14 ft. 4 in. "
" 24 in. " " 12 ft. 8 in. " " 2 ft. 4 in. = 15 ft. 0 in. "
" 26 in. " " 14 ft. 0 in. " " 2 ft. 4 in. = 16 ft. 4 in. "

Number of Retorts in a Bench.—Taking each of the three above arrangements, we can vary the number of retorts by increasing the number of retorts in height of each, so that in the first we have 6, 8, or 10, in the second 6, 9, 12, or 15, and in the third 8, 12, 16, or 20 retorts to the bench; and then, taking each of the different sized retorts in each of these benches, and calculating therefrom the values of AN and AN÷L, we have the whole matter brought down to a basis of comparison which will show the amount of retort floor surface per foot of bench front.

The results of these calculations are given in the following tables. Of course it is to be understood that the main point under consideration is the economy of retort house room; and in some of the cases treated difficulties will arise as to the arrangement of standpipes, etc. But these need not necessarily be considered until afterward. It will be found that the additional thickness of the piers will make it easy to arrange a larger number of standpipes to each bench than would be possible with thin piers.

TABLE I.

Width of Arch.	Thickness of Pier.	L = Bench Front.	Width of Retorts.	A = Area of Bottom of Retort.	N = Number Retorts in a Bench.	AN	$\frac{AN}{L}$	Thickness of Retort.	Total Space Outside Retorts.	Number of Spaces.
ft. in.	ft. in.	ft. in.	in.	sq. ft.		sq. ft.	sq. ft.	in.	in.	
6 0	1 6	7 6	22	18.33	6	110.00	14.66	3	16	3
6 0	1 6	7 6	22	18.33	8	146.66	19.55	.....	.....	.....
6 0	1 6	7 6	22	18.33	10	183.33	24.44	.....	.....	.....
6 4	1 6	7 10	24	20.00	6	120.00	15.19	.....	.....	.....
6 4	1 6	7 10	24	20.00	8	160.00	20.42	.....	.....	.....
6 4	1 6	7 10	24	20.00	10	200.00	25.53	.....	.....	.....
7 0	1 6	8 6	26	21.66	6	130.00	15.29	4	.....	.....
7 0	1 6	8 6	26	21.66	8	173.33	20.39	.....	.....	.....
7 0	1 6	8 6	26	21.66	10	216.66	25.50	.....	.....	.....
8 6	2 0	10 6	20	16.66	6	100.00	9.52	3	24	4
8 6	2 0	10 6	20	16.66	9	150.00	14.28	.....	.....	.....
8 6	2 0	10 6	20	16.66	12	200.00	19.04	.....	.....	.....
9 0	2 0	11 0	22	18.33	6	110.00	10.00	.....	.....	.....
9 0	2 0	11 0	22	18.33	9	165.00	15.00	.....	.....	.....
9 0	2 0	11 0	22	18.33	12	220.00	20.00	.....	.....	.....
9 6	2 0	11 6	24	20.00	6	120.00	10.44	.....	.....	.....
9 6	2 0	11 6	24	20.00	9	180.00	15.66	.....	.....	.....
9 6	2 0	11 6	24	20.00	12	240.00	20.88	.....	.....	.....
9 6	2 0	11 6	24	20.00	15	300.00	26.10	.....	.....	.....
10 6	2 0	12 6	26	21.66	6	130.00	10.40	4	.....	.....
10 6	2 0	12 6	26	21.66	9	195.00	15.60	.....	.....	.....
10 6	2 0	12 6	26	21.66	12	260.00	20.80	.....	.....	.....
10 6	2 0	12 6	26	21.66	15	325.00	26.00	.....	.....	.....
11 4	2 4	13 8	20	16.66	8	133.33	9.76	3	32	5
11 4	2 4	13 8	20	16.66	12	200.00	14.64	.....	.....	.....
11 4	2 4	13 8	20	16.66	16	266.66	19.52	.....	.....	.....
11 4	2 4	13 8	20	16.66	20	333.33	24.40	.....	.....	.....
12 0	2 4	14 4	22	18.33	8	146.66	10.24	3	32	5
12 0	2 4	14 4	22	18.33	12	220.00	15.36	.....	.....	.....
12 0	2 4	14 4	22	18.33	16	293.33	20.48	.....	.....	.....
12 0	2 4	14 4	22	18.33	20	366.66	25.60	.....	.....	.....
12 8	2 4	15 0	24	20.00	8	160.00	10.66	.....	.....	.....
12 8	2 4	15 0	24	20.00	12	240.00	16.00	.....	.....	.....
12 8	2 4	15 0	24	20.00	16	320.00	21.33	.....	.....	.....
12 8	2 4	15 0	24	20.00	20	400.00	26.66	.....	.....	.....
14 0	2 4	16 4	26	21.66	8	173.33	10.01	4	.....	.....
14 0	2 4	16 4	26	21.66	12	260.00	15.03	.....	.....	.....
14 0	2 4	16 4	26	21.66	16	346.66	20.02	.....	.....	.....
14 0	2 4	16 4	26	21.66	20	433.33	25.03	.....	.....	.....

For the purpose of classifying these values of AN÷L, I have arranged the following table, wherein I have grouped the different settings of sixes, eights, etc., themselves:

TABLE II.

Settings of Sixes.

6′	arch	3	high and	2	wide	22	in.	retorts	14.66 sq. ft. per foot front.
6½′	"	3	"	2	"	24	in.	"	15.19 " "
7′	"	3	"	2	"	26	in.	"	15.29 " "
8½′	"	2	"	3	"	20	in.	"	9.52 " "
9′	"	2	"	3	"	22	in.	"	10.00 " "
9½′	"	2	"	3	"	24	in.	"	10.44 " "
10½′	"	2	"	3	"	26	in.	"	10.40 " "

Settings of Eights.

6′	arch	4	high and	2	wide	22	in.	retorts	19.55 sq. ft. per foot front
6½′	"	4	"	2	"	24	in.	"	20.42 " "
7′	"	4	"	2	"	26	in.	"	20.39 " "
11½′	"	2	"	4	"	20	in.	"	9.76 " "
12′	"	2	"	4	"	22	in.	"	10.24 " "
12½′	"	2	"	4	"	24	in.	"	10.66 " "
14′	"	2	"	4	"	26	in.	"	10.01 " "

Settings of Nines.

8½′	arch	3	high and	3	wide	20	in.	retorts	14.28 sq. ft. per foot front.
9′	"	3	"	3	"	22	in.	"	15.00 " "
9½′	"	3	"	3	"	24	in.	"	15.66 " "
10½′	"	3	"	3	"	26	in.	"	15.60 " "

Settings of Tens.

6′	arch	5	high and	2	wide	22	in.	retorts	24.44 sq. ft. per foot front.
6½′	"	5	"	2	"	24	in.	"	25.53 " "
7′	"	5	"	2	"	26	in.	"	25.50 " "

Settings of Twelves.

8½′	arch	4	high and	3	wide	20	in.	retorts	19.04 sq. ft. per foot front.
9′	"	4	"	3	"	22	in.	"	20.00 " "
9½′	"	4	"	3	"	24	in.	"	20.88 " "
10½′	"	4	"	3	"	26	in.	"	20·80 " "
11½′	"	3	"	4	"	20	in.	"	14.64 " "
12′	"	3	"	4	"	22	in.	"	15.36 " "
12½′	"	3	"	4	"	24	in.	"	16.00 " "
14′	"	3	"	4	"	26	in.	"	15.03 " "

Settings of Fifteens.

8½′	arch	5	high and	3	wide	20	in.	retorts	23.81 sq. ft. per foot front.
9′	"	5	"	3	"	22	in.	"	25.00 " "
9½′	"	5	"	3	"	24	in.	"	26.08 " "
10½′	"	5	"	3	"	26	in.	"	26.00 " "

Settings of Sixteens.

11½′	arch	4	high and	4	wide	20	in.	retorts	19.52 sq. ft. per foot front.
12′	"	4	"	4	"	22	in.	"	20.48 " "
12½′	"	4	"	4	"	24	in.	"	21.33 " "
14′	"	4	"	4	"	26	in.	"	20.02 " "

Settings of Twenties.

14′	arch	5	high and	4	wide	26	in.	retorts	25.03 sq. ft. per foot front.
12½′	"	5	"	4	"	24	in.	"	26.66 " "
12′	"	5	"	4	"	22	in.	"	25.66 " "

In examining these groups one singular fact presents itself—viz., that in almost every case a 24 in. retort gives the most economical result in each class, besides being very convenient for calculation, as its area is just 20 feet. The settings of 15 retorts give the best results. The settings of nines give better results than the settings of sixes, and eights, in the smaller arches, are better than tens. Tens are better than either eights or twelves or sixteens, and benches of twenty retorts are a little better than tens.

Economy of labor is to be considered in connection with this matter, and it is self-evident that the more retorts we have to a fire the less labor will be required; so that a bench of nines should show an economy of labor over either sixes or eights. Of course the very large benches can only be adapted to the very large works, where the suspending or letting down is done by wholesale. The variation in the demand for gas must largely enter into the solution of the problem as to the number of retorts to be put into a bench; but having determined this point, the above tables may be of service in deciding what arrangement of retorts to adopt in almost any case. It would seem that a bench of nine 24 in. retorts, for any works of sufficient capacity to use it, would be almost as good as any, when we consider the facility with which drawing and charging machinery would operate them, the ease with which they can be heated by generator furnaces, and the ready way that standpipes can be arranged for them.

I would remark in this connection that it is almost the universal practice in Germany, in their modern works, to employ benches of nines arranged in single line about three feet from the retort house walls, and in large works a range on each side facing inward. They have houses with cellars, or stage houses. The bench walls are thick, and the radiation small. No people investigate more patiently or carefully than the Germans, and they seldom adopt a system without a reason; and if confimation were needed of what we work out ourselves, I believe it may be found in German construction when we are right.

Of course, the model retort house is not yet built; but when it is, it would appear to be more than probable that it would prove the truth of the "decimal system," as before propounded—viz., 100,000 cubic feet of gas per day from a bench covering 100 square feet; each retort to carbonize a ton of coal per day, and the coal to be handled by machinery in such a way that it may not be touched by hand from the time it leaves the mines till the coke is dumped in the consumer's cellar. Cheap gas is what is demanded by all; and that will be the way to make it.

[From the "Journal of the Society of Arts."]

Gas for Lighthouses.

By JOHN R. WIGHAM.

Read before the Society of Arts, London, March 15, 1882.

A century has just elapsed since a native of Geneva, Aimé Argand, did great service to artificial illumination by the introduction of the lamp which bears his name. It may be said of his important invention that when it left his hands it was practically perfect. The Argand burner of to-day is substantially the same as that constructed by him in 1782, and the principle on which it was constructed is the basis of all the oil lamps and gas lamps which have cylindrical flames to the interior of which air is admitted, to promote combustion, while a similar current is brought to the exterior by the use of a glass chimney.

Notwithstanding the manifest advantages of the Argand lamp, lighthouse authorities were slow to adopt it. We find that, more than 30 years after its introduction (in 1816), the light of the Island of May (Firth of Forth) was from a coal fire; and the famous Eddystone had only tallow candles as its illuminant till 1807, when they gave place to Argand lamps with parabolic reflectors. Here is one of these lamps as at present used, with its reflector. This burner is one of the Trinity-house pattern, its flame is from colza oil, but it is also capable of being used for parffin oil. With either, good flames are produced, but a still better light may be obtained from a gas burner such as this, which requires no glass chimney and is easier of manipulation. I will presently substitute it for the oil burner. I get much more light, and I can increase its power for foggy weather in a moment, and equally quickly reduce it again to the strength required for clear weather. The light from oil lamps can also be increased for foggy weather, but not so easily as is the case with gas.

I will now light the gas burner in the reflector. This smaller parabolic reflector is the size used for floating lights. You will see that it is mounted in such a manner that, no matter how much the ship may roll or pitch, the light is maintained perfectly level.

CATOPTRIC LIGHTS.

These reflector lights at which we have been looking are still much used in lighthouses, both for fixed and revolving lights. You have seen, as I moved them up or down, that the light was reflected from every part of the reflector, and that it was transmitted in a nearly parallel beam. For a first order lighthouse, a number—say 20 to 26—of such reflectors are placed side by side and over each other, in the manner shown in the diagram on the wall. The lights of the lamps blend, and show a great illuminated surface to the observer. This constitutes what is called the catoptric system of lights.

INTERMITTENT LIGHTS.

The use of gas for all lighthouse lamps has this great advantage over oil, that where intermittent lights are required, gas is not only turned off and on very easily, but at each intermission the consumption of gas is stayed. This cannot take place when oil is used, for the oil lamp must be eclipsed by the interposition of opaque shades, the consumption of oil continuing all the time of each eclipse, whereas gas flames are extinguished by cutting off the supply of gas, and thus, during the period of darkness, the consumption of the gas is saved.

Whilst speaking of intermittent lights, perhaps I may further say in this place that for lighthouses not only have we in gas a source of illumination superior, in my mind, to any other, but also an exceedingly useful motive power. I do not now refer to gas engines, the great value of which for lighthouse purposes I shall have to mention further on, but to the ordinary pressure of gas, by which we are enabled, in some cases, to actuate mechanism for causing the intermissions of the light, and thus dispense with the costly clockwork usually employed for the purpose. We are all familiar with the gas "Barker's mill," by which lights of gas are caused to revolve simply by the force with which the gas issues from the orifices at which it is burned. This is one example of the motive power to which I refer. Again, the great draught caused by the ignition of gas under tubes such as those now used at lighthouses is capable of rotating a powerful fan, by which the valves admitting the gas to the burners may be turned on and off as required. Another method of turning gas off and on automatically, which I have recently devised, is shown by a diagram on the wall. The heat of the gas flame expands air in the copper ball suspended over it. This expansion of the air raises a column of mercury in the tube connected with the ball, and the mercury thus raised cuts off the supply of gas to the burner, by sealing the mouth of the tube through which the gas issues. As soon as the gas is extinguished the air in the ball becomes reduced to its normal density, and the mouth of the gas tube is unsealed, causing the flame to spring up as before. Of course, a small bye-pass is used, admitting an almost invisible flame to the burner, for the purpose of relighting it. This method of automatically intermitting lights is not practical under the oil system.

COST OF GAS.

The cost of gas, even when fixed lights are used, is but little in excess of oil. The Parliamentary papers which have been published show that the annual cost of a gas station is, in some cases, greater by about £40 than an oil station; but they also show that the cost of gas is much less than oil when the cost of the fog powers of the former is not added, and that taking the superior light of gas into consideration, its cost is much less than oil. (See Appendix.)

DIOPTRIC LIGHTS.

Fresnel, the great French optician, and the not less eminent Scottish philosopher, Sir David Brewster, are both entitled to the honor of introducing for lighthouses what is known as the dioptric system. In this system, instead of using many small lights, each in the focus of its own reflector, one large lamp only is employed, and fixed in the center of cut-glass lenses, which refract the light and transmit it to the horizon, performing precisely the same office as reflectors, but doing the work in a different manner. I have here dioptric apparatus for a "fixed light" of what is called the first order. You will see that it is divided into three portions—the center (which is called the great refracting belt), the top zones (or prisms), and the bottom prisms. The effect of this apparatus is to send a parallel beam to every part of the horizon. I have also here this annular lens, also of the first order for revolving lights, and as I thought you would be interested in seeing practically the effect of lenses for revolving lights, I have arranged it so that it may be moved and cause its characteristic beams or flashes of light. It is perhaps needless to mention that the power of each beam from a revolving light is vastly greater than that from a fixed light, inasmuch as in the case of the latter the light radiates from the center to the whole horizon, but in the former it is intercepted and condensed into eight beams. It is obvious that these powerful beams would never reach all parts of the horizon if the apparatus were not caused to revolve. You will notice that the angles of darkness are very large. I hope to show you practically, when we light our burners, how small a portion each beam illuminates when not revolving. We are this evening indebted to the Commissioners of Irish Lights for the use of these dioptric apparatus which they have kindly lent me for experimental purposes.

The oil lamps which are used for dioptric apparatus are Argand lamps having concentric wicks, 2, 3, 4, and 6 in number. Here is a 4-wick lamp and chimney. I have not lighted it, because it is difficult in a room like this to maintain the perfectly even draught in the flue which surmounts the glass chimney, without which draught the lamp is liable to smoke and vary in illuminating power. A full-sized drawing of this lamp is on the wall, and also one of the 6-wick oil lamp, which is the largest in use. I am informed that still larger lamps are being experimented upon. If the experiments prove successful it will be important for some lighthouses, for—for the reasons which will presently appear—I consider an increase in the size of our lighthouse illuminants will be of great advantage.

I come now to the main subject for our meeting to-night, viz., the introduction of gas for dioptric lights for first-order lighthouses. It is perhaps known to some who are present that the Commissioners of Irish Lights were the first lighthouse authorities to make use of gas as an illuminant for important lighthouses. They have done me the honor of adopting the arrangements and burners for the consumption of gas which I have devised from time to time. My aim has been to obtain the greatest possible intensity with the greatest possible volume in the gas flames which I employed. Before showing you these flames I may perhaps be permitted, for a few minutes, to explain some of the steps by which I was led to construct gas burners for lighthouses in the form in which they are now used.

CONSTRUCTION OF BURNERS.

As I have before stated, only Argand burners have been used for the combustion of oil in first-order lighthouses, and one of the first things I did was to construct Argand burners for gas, with concentric rings. I also, by a very simple process, converted the 4-wick oil lamps into 4-ring Argand gas burners, and burned the gas with an ordinary oil lamp chimney.

Here is a lamp which I altered in this way many years ago. I found that by carefully regulating the air passages a good light in both cases was obtained, but that the full advantage of rich cannel gas, which, for obvious

reasons, is that used at lighthouses, could not be developed by Argand burners. The fact that Argand burners do not give as good photometric results with rich as with poor gas has been long known to gas engineers. I proved it to my own satisfaction by my experiments, and I also found that glass chimneys for large lights were troublesome, liable to breakage from accident as well as from varying temperature, and required careful cleaning; besides which the cleanest glass presents some obstruction to the transmission of light. I therefore sought for another plan of applying gas which would not have the disadvantage of requiring the use of glass, and would develop the full power of cannel gas. It occurred to me that if any plan could be devised by which the excess of carbon—the smoke—existing in rich gas flames, could be turned to account as a means of increasing their illuminating power, a valuable desideratum would be obtained. I accordingly made many experiments with that object, and came to the conclusion that I could find no better basis for my efforts to that end than the ordinary well-known fishtail jet, or a combination of burners or jets of the fishtail or batswing type. The fishtail jet, it is hardly necessary to say, is bored diagonally on opposite sides of a small internal cone. The streams of gas issuing from the orifices impinge against each other with considerable force, and the result is the thin sheet of flame with which we are so familiar. This flame, possessing a large surface to which the oxygen of the air readily gains access, is in consequence rendered brilliant and comparatively smokeless. But on closely examining the flame of a fishtail burner it will be seen that toward the top, where the force of the stream of gas is nearly expended, it is thicker, and inclined to be smoky. The larger the bore of the burner the thicker the stream of gas, and (its pressure and quality being good) the greater the amount of unconsumed carbon.

When a number of fishtails are arranged so that the upper extremities of their flames touch each other, they run up (because of the absence of air between each jet) into somewhat smoky tails; but the light they give when thus united is increased, with hardly any increased consumption of gas, much beyond the mere multiple of the illuminating power of their single flames, as may be seen in a momont by bringing two fishtails together. I made this peculiarity of the fishtail available for producing a large flame of high illuminating power, and I devised this form of burner. I used in its construction double jets (a simple form of governor), by which a more effective combustion of gas is attained, with less consumption for each jet, than in the burners which I used in my earlier experiments. The principle of the double jet is not new, but I believe that the present form of its application was entirely so. It is exceedingly simple, and may be explained by this ordinary gas burner.

Having thus obtained a maximum of illuminating power from each jet, it remained to build up of such burners a flame suitable for lighthouses, and in doing so, to make use of means to utilize the smoky part of the united flame. I accordingly placed an overhanging flue of suitable size above the burners, so as to effect this object by the indraught of air upon the top of the flame. The power of the burner is therefore obtained not only by the peculiar arrangement of numerous fishtail jets, but by suspending over the flame which they unitedly poduce an oxidizer of talc or other material, by means of which a current of air is brought into contact with its smoky part, rendering it not only smokeless but exceedingly white. The combustion is also assisted by a bottom cone, for equalizing a current of air to the flame. The oxygen of the air is thus twice utilized—first, at the bottom of the flame, through the medium of the several fishtail burners, and, secondly, at the top of it, where its action raises to a white heat the large quantity of solid carbon found there. This may be seen if I light the burner, which, I may mention, is of the size used for ordinary clear weather in lighthouses.

POWER OF BURNERS.

I have here a complete lighthouse gas burner. It is so constructed that a light-keeper can increase the power of the light by five steps, according as the state of the weather may require from the burner used in clear weather, consisting of 28 jets, such as I have just lighted, to the second, third, fourth, and fifth fog powers, consisting of 48, 68, 88, and 108 jets respectively. The illuminating power of each of these burners, as ascertained by Dr. Tyndall, in an official investigation which he made on the subject at Haisbro' Lighthouse, are shown in the table on the wall as respectively 429, 832, 1,253, 2,408, and 2,923 standard sperm candles, while the power of the largest lighthouse oil lamp at present used is but 722 candles. The changes from one power to another can be made very quickly by the use of a peculiar arrangement of mercurial joints, as I shall now show you.

These large burners at which we have just been looking may be termed fog burners. We all know, especially those among us who reside much in London, that there are fogs capable of obscuring any artificial light, and that even the sun's rays can but feebly penetrate dense fog; but at sea, when fogs are not very dense, or when the weather is merely what is called thick, and sufficiently so to obscure ordinary lights, then it is that the mariner derives the benefit of the powerful lights such as I have just shown you.

These gas lights are used at six lighthouses in Ireland—Howth Bailey, Rocabill, St. John's Point, Wicklow Head, Mine Head, and Hook Tower—and at the two Haisbro' lighthouses in England. They are also used in a different form at Galley Head, County Cork, as I will presently mention more particularly. Some of these lights have been 17 years in use; they have never failed, and have always given great satisfaction to the sailors using them. Dr. Tyndall, scientific adviser to the Board of Trade, examined these lights from time to time and reported upon them. His reports agree with those of the mariners, and they very authoritatively pronounce gas for lighthouses to be superior to all oils.

It may be asked, under such circumstances, why the system has not made further progress, and why, with one exception, no lighthouse has been supplied with gas since 1873. In 1875 the Trinity House advised that the gas system should be further developed; but the further development has not taken place. The Commissioners of Irish Lights have again and again asked the sanction of the Board of Trade for the further extension of the system, but the extension has not taken place, although there is now some sign of improvement. This is not the time nor the place to investigate this part of the subject. Perhaps some time a chapter may be written upon it. But meanwhile I think I may venture to say that the delay has not arisen from any inherent defects in the gas system, or because a better plan has superseded it; all the evidence is the other way. Mariners still think as highly of it as when it was first introduced; and quite recently the Commissioners of Irish Lights received testimony from captains of steamers passing their gas lights, to the effect that in fogs, by their means, they could ascertain the position of a lighthouse when, owing to the thickness of the weather an ordinary lighthouse could not be seen.

I will now light a gas burner in each of the two kinds of dioptric apparatus which are here, and will move the annular lens, that you may judge of the comparative effect of revolving lights and fixed lights.

LARGER LENSES.

If, instead of using any of these ordinary lighthouse lenses, which were designed for oil lamp flames, 4 inches in diameter by 3½ high, I were to use a lens made to suit my large 108 jet gas flame, which is nearly 12 inches in diameter by 8½ inches high, I need not say the illuminating effect would be enormously greater. I trust that before long lighthouse authorities will sanction the construction of such lenses, and so gain the full benefit of the large flames, which have, so far been only produced by gas.

QUADRIFORM LIGHT.

Being fully convinced, from long practical observation, of the importance to the sailor of using large lights in illuminating fog, I determined to push that principle to the utmost limit permitted by the lenses now used in lighthouses, and I devised a plan by which, in foggy weather, double, treble, and quadruple the power of the largest gas light and lens at which we have been looking, can be obtained. This plan, which has been termed the biform, triform, and quadriform system, consists in placing two, three, or four burners, vertically, over one another, and making an arrangement by which the products of the combustion of the lower burners are intercepted and turned outward, so as not to interfere with the upper burners, while a supply of pure air is conveyed to each of them by cylindrical openings, brought through the flues. The air thus introduced is sucked in briskly by the draught, and much heated by its contact with the nearly red-hot casing of the internal flue, as is also the gas, the pipes for which are in the hot chamber. The illuminating power of the upper flames is materially increased by this arrangement.

That you may clearly understand the manner in which these lights are burned one above another, I have here arranged two such lights of small size, and you will observe that so far from the upper being injuriously affected by the lower light, it is improved by the high temperature at which it is burned, and the constant supply of fresh air which is sucked in by the apparatus, which I have described. Without this apparatus, the upper lights would have hardly any illuminating power.

I have here a model of the quadriform apparatus at Galley Head. There are 32 lenses arranged in four tiers, 8 in each tier. Each lense is of the size of this first-order lens, and one of these powerful gas lights is placed in the focus of each tier; thus there are eight pillars of light, about 13 feet 6 inches high and 3 feet wide, the great beams from which are continually visiting every part of the horizon. A full-size elevation of the lenses is on the wall.

The great illuminating power (calculated to be more than a million candles) of this lighthouse, it is to be remembered, is completely under the control of the light-keeper; only one-fourth of it is applied in clear weather, the other three portions being added as the weather thickens. This light, though the largest in the world, is also one of the most economical, only about one-half of the quantity of gas which would be used in an ordinary flashing light being consumed. This arises from its being what is termed a group flashing light—that is the flashes from the lenses, instead of

being single flashes, as usually exhibited at lighthouses, are each of them, by the continual extinction and re-ignition of the gas, broken up into four or five beams, which constitute a group of flashes recurring at regular inter vals, thus presenting a very distinctive light for the guidance of mariners. This is accomplished by the same clockwork machine by which the lenses are caused to revolve. The interval between the group of flashes is one minute, the interval between the flashes composing each group is about two seconds; thus there are two seconds of light followed by two seconds of darkness, during which the gas is cut off; hence the economy.

One word more as to flashes. Just as the suddenness of the flash of a gun catches the eye, so the effect produced on a fog when these large gas burners are suddenly lighted is very striking; and the use of gas as an intermittent light for lighthouses purposes is valuable, not only because of its economy (the intermissions, as I have said, being due to the cutting off and and consequent saving of the gas), but also because of its illuminating effect on fog by the sudden exhibition of its great light.

Since the completion of Galley Head Lighthouse the Commissioners of Irish Lights have received from the commanders of the great ocean steamers which pass Galley Head the most satisfactory testimonials as to its power and distinctiveness. I will only quote one of many testimonials. Captain Glendall calls it "a most powerful, strongly marked, and appropriate light, and of great service to shipping navigating that part of the Irish coast, it being so readily distinguished from all others in its vicinity."

Dr. Tyndall visited it and reported that, supposing its group flashing apparatus dispensed with, it would be a revolving light "surpassing any other in the world." Its burner is of 68-flame size; but were the power of the burner reduced to 48-flame instead of 68-flame, "the light with its full strength evoked would still transcend all other revolving lights."

EX-FOCAL LIGHT.

Before leaving this part of the subject I may be permitted to say a few words respecting one of the most important advantages of gas used in the manner I have just described for lighthouses. This advantage consists in the great amount of ex-focal light which is transmitted by the ordinary lenticular apparatus, owing to the large size of the gas flame. At the last meeting of the British Association, I introduced this subject, and quoted striking testimony, from seamen and other persons qualified to judge, to the effect that, by means of this ex-focal light, a mariner is enabled in foggy weather to see the position of a lighthouse which, unassisted by the ex-focal light, would not be visible. Time will not permit me now to repeat this evidence which, however, is easily obtained, it having been printed for circulation; but the cause of that good effect is obvious.

You will observe that the gas burners have, to a greater extent than the oil lamp, what are termed tails of light, reaching up into the overhanging flue; these tails are, of course, ex-focal, and a considerable amount of their light is directed towards the sea, and thus illuminates it at the base of the lighthouse. The effect of the upper prisms, at which we have been looking, is to throw the light from these tails upwards towards the sky, as shown in diagram. While it is useful to throw down light so as to illuminate the sea at the base of the lighthouse, it is, I venture to say—notwithstanding the opinion of some opticians—still more useful to direct light towards the sky in order to illuminate the mists and fogs, more or less dense, which frequently hang over the headlands and islands upon which our lighthouses are built. The effect of the top and bottom prisms is, however, feeble compared with that of the central belt, and for this reason—as you have already noticed in the case of Galley Head—I would discard their use altogether for great sea lights in which gas is used. In looking at these diagrams, it may be well for me to remind you that the light represented by the lines shown in them is not of the nature of ordinary diffused light—such as proceeds from naked flames, which follows the law of diminution according to the square of the distance—but is directed light, and follows a definite path, with but little diffusion; and this applies as much to the light which is ex-focal as to that which is focal.

Now, as to the effect of the fog powers of the gas light. Looking at the diagrams on the wall, it must be plain that as the gas flames are enlarged in diameter, there will be ex-focal light from that increased diameter (and still more from the greater heights of the flames), but it is also evident that there will be also very greatly increased intensity in the focal light, due to the increased depth of the flame. Surely there must be a great deal more strictly focal light given by the 108-jet burner, 2,903 candles, than by the 4-wick oil lamp, 328 candles? and surely it is plain that this increase of focal light arises from the portion of the flame which is ex-focal? yet, strange to say, these facts have been disputed.

The advantages I have pointed out as possessed by large gas flames over flames of the ordinary focal size, are to be found in revolving lights, as well as in fixed lights. I do not, however, propose to occupy your time in considering that branch of the subject, further than to say that these large flames are applicable to the dioptric apparatus of first order lights of every kind, and, indeed, to any order of dioptric apparatus down to the sixth or smallest.

Useful as are the results of ex-focal light in the cases of which we have been speaking, its advantages are still more manifest in the triform and quadriform lights. For the reasons before given, in this form of light, I discard the upper and lower prisms, and only use the central refracting belts, or the annular lenses, of which we have been speaking. Another diagram shows that the rays from the middle burner pass beyond their own lens to the upper and lower lenses, and are directed upwards and downwards, illuminating in their passage any mists they may encounter; and not only is it from the middle burner that this takes place, but the top and bottom burners also transmit their light through their own. and through the middle lens, so that, besides the direct focal beam of the three combined lenses, there is a halo of ex-focal light all around them, of such large size as to be exceedingly helpful to the mariner in thick weather. I was interested, when visiting the recent Exhibition in Paris, to find that Messrs. Sautter, Lemonier & Co., the well known optical engineers, are constructing for the Russian Government, lenses, for the express purpose of throwing beams of light into the sky, to enable seamen to know the position of a lighthouse from which they were separated by a headland. It is evident that the Russian authorities do not agree with the engineers in this country, who have maintained that beams of light which do not directly reach the eye are of no value to the mariner, and in this connection I may mention that I have recently devised an entirely new plan of horizontal and skyward flashing lights, which I hope may be of great use to the mariner; I intend very soon officially to make known its details.

ELECTRIC LIGHT.

The dimensions of the usual lanterns and dioptric apparatus of lighthouses not permitting us to use gas lights of a larger size than that which I have just described, it seemed desirable to consider whether we could not usefully add still greater intensity to our lighthouse gas flames than that obtainable from gas only. All our intense lights, such as the lime light, the electric light, magnesium light, etc., are costly; but it occurred to me that, if I could add some such intense light to my large gas burners, so arranged that it need not be used except in thick weather, I would, at comparatively small expense, produce a fog-light, combining both quantity and great intensity. I made many experiments, and at length arranged for what I termed a core for my gas burners. Any of the intense lights I have mentioned might form this core. I first used, as the simplest and least expensive, a rich hydrocarbon flame intensified by oxygen, such as I may, in passing, show you in this lightship lamp, that you may see its effect in increasing the intensity of the flame. I tried the electric light also for this purpose, because of its great intensity, and because of the facility with which, owing to the recent improvements in dynamo electric machines, it can be applied. The light from carbon points regulated by a Serrin or Siemens lamp is quite available for the purpose. By a simple alteration in the arms which hold the carbons, and of the clockwork by which those arms are moved, we can bring the light into the precise focus of the gas burner, and apply it at pleasure. By means of a gas engine, which of course can be used at all gas stations, this can be done in a moment. I have read small print at Salthill by the light transmitted from these combined lights at Howth Bailey Lighthouse, almost six miles distant, a test of the power of a lighthouse light more severe than has ever before been applied, so far as I am aware. But powerful as this combination is, my experience of the behavior of the electric light in foggy weather is such as to prevent my proceeding further with experiments in that direction. At the last meeting of the British Association I had the opportunity of laying the result of my observations before that scientific body. Briefly summed up, it is this—that while the electric light is much more intense than gas light, there is a double objection to its use at lighthouses.

1stly. That in clear weather it is misleading to the sailor, he cannot be certain of his distance from it. In some states of the atmosphere it looks equally bright whether it be ten miles off or only one.

2ndly. In foggy weather, when a light is specially needed, it is more easily totally obscured by fog than the large gas lights, combining quantity with intensity, which are now used for lighthouses, and which have again and again been seen in fogs in which the electric light has been quite invisible.

The opinion of many scientific men has been adduced to this effect, and the evidence is so strong, that it seems to me that the conclusion is inevitable that the electric light is not well adapted for lighthouses. Would it not be wise, in the interests of the maritime public, that the question should be thoroughly investigated, with the view of ascertaining whether it is right that this light should be used any longer at lighthouses.

BEACONS.

When it is desired to establish and maintain lights upon beacons where space is limited, and to which access by boat is difficult or expensive, gas

properly dried by chloride of calcium may be very conveniently applied as the means of illumination. A gas station on shore will command any desired number of beacons, and the lights may be simultaneously lighted and extinguished from the shore. The plan I have adopted, and exhibited in operation to the Commissioners of Irish Lights, is very simple; during the day time the gas is supplied at a pressure, say, equal to a column of water six inches high, to maintain a small light about the size of a pea in the lantern of each beacon. The gas for this light is driven through a bye-pass in the valve of an automatic gas governor of suitable size fixed on each burner and the high pressure at which the gas is supplied prevents wind, or any slight movement of the supply pipe, from causing the extinction of the small flame which thus remains as the permanent lamplighter of the beacon. At night-fall, when the time arrives for exhibiting the light in the beacon, the pressure at the shore station is diminished from six inches to, say, one inch, and this reduction in pressure immediately acts upon the governors which are attached to each light, causing their valves to open and thus admit gas for a full-sized flame. When the beacon light requires to be extinguished, the reverse process is gone through, the pressure on shore is increased, the governor valve rises and extinguishes the light, leaving, however, the small bye-pass pea-sized flame ready for the performance of its function of lamplighter on the next occasion. The little apparatus I have here will clearly illustrate this method of illuminating beacons. I will put it into action. You will see that to light and extinguish the light at the opposite side of the room, I simply reverse the ordinary plan to which we are accustomed. I turn off this cock to cause the lights to spring up, and I turn it on to extinguish the light.

ATMOSPHERIC GAS.

At certain lighthouse stations there is hardly room for ordinary coal gas apparatus, although there are very few where space is so limited; but in cases like the Eddystone, Bell Rock, Fastnet, and others, an "atmospheric" gas machine is available. I do not now intend to enter into the merits of air gas as compared with ordinary coal gas. Much has already been written on the subject; nor is gas of this kind any novelty; it is nearly as old as the country in which we are living: I merely wish to submit that it is in a peculiar manner suitable for such purposes as the illuminating of rock lighthouses where coal gas is difficult of application. I may, perhaps, be permitted to remind you that air gas is not explosive, except in the same way that coal gas is explosive. This has been abundantly proved by its application without any accident whatever in many hundred cases to the ordinary illumination of country houses, and by the numerous experiments which have been made in attempting, without success, to explode mixtures of any proportion of hydro-carbon vapor and air burned under ordinary pressure. That air can be so charged with carbonaceous vapor as to form an illuminating gas of constant illuminating power, the operation of the apparatus which I have here would clearly prove. As in all air gas machines, a current of air is impregnated with the vapor of such volatile liquids as may be employed for the purpose. I prefer a volatile product of Young's paraffine, but the peculiarity of this apparatus consists in the manner in which atmospheric air is saturated.

The principle upon which this part of the apparatus is constructed, is similar to that of the ingenious water-heater of Mr. Maughan. You are aware that, by one of these useful water-heaters, we can, in less than a minute, make a stream of cold water so hot as to be unbearable to the hand. This rapid change is effected by means of coils of wire, upon and within which drops of water are so finely divided, as to be immediately vaporized by the heat of the gas flame. This is a coiled wire, such as is used in the apparatus. I apply the same principle to my gas machine; just as water finely divided is quickly heated by the hot vapor of lighted gas, so does the hydrocarbon vapor of the liquid in the gas machine, when finely divided, quickly and thoroughly saturate the air with which it is brought in contact. A cylinder made of spiral wires is caused to revolve by the same weight which drives the air-blower, and by which a constant pressure is maintained. One half the cylinder is submerged in the volatile liquid contained in the lower part of the apparatus, and the result is gas of high illuminating power. An atmospheric gas machine of small size is on the table.

The cost of this gas is about the same as that of ordinary coal gas, but its advantage over home-made coal gas is the simplicity of the apparatus by which it is produced, requiring neither fire, nor retorts, nor gasholders, but little attendance (say a few minutes per day), and no special knowledge on the part of any person in charge of it. Gas of this kind has also the very great advantage that the products are as harmless as those evolved from the purest wax, and cannot tarnish the silver plating of reflectors, or injure other things, upon which the products of coal gas sometimes act detrimentally

GAS GUNS AS FOG SIGNALS.

The great importance to navigation of audible fog signals is now universally admitted. Amongst those which have been suggested are gas guns. Some years ago, when I was engaged for the Commissioners of Irish Lights in fixing gas making apparatus at several of their lighthouses, in order that gas might be used instead of oil, as the illuminant, it occurred to me that it would be convenient to use the gas available at such lighthouses for gas guns, as fog signals. With the sanction of the Commissioners I fixed gas guns of various sizes at Howth Bailey Lighthouse, and Dr. Tyndall and other gentlemen connected with the Board of Trade experimented with them. The noise of the gas gun is caused by the explosion of a mixture of oxygen and coal gas. We are all familiar with such explosions in the lecture room, but gas guns capable of producing a noise loud enough for a fog signal have only been tried, so far as I am aware, at Howth Bailey Lighthouse.

This mode of signalling has a very important advantage, viz., that the gun may be fixed at the water's edge, or on a rock in the sea, at a considerable distance from a lighthouse or fog-signal station, and can be loaded and fired as often as required from the station without necessitating the lightkeepers leaving their post, the noise of the explosion and the flash (in itself a good fog-signal) being all the while at the point of danger. It is easy to imagine that such a point, say an isolated rock, might be too small to hold an ordinary gun, and be so inaccessible from the lighthouse as to render the attendance of a gunner almost impossible.

In order to show how these guns are used, I have fixed one of small size in the far corner of the room, which, for the occasion we may call an outlying rock, and connected it by an iron tube with this lecture table, which we may call a lighthouse on shore. This gasholder contains the charge, which, of course is gaseous, and not solid as in the case of an ordinary gun. So soon as I have loaded the gun—which you will see that I do by simply opening a cock—I apply a light here at the shore end of the tube, by percussion cap or otherwise, and the gun at sea is fired. It will be seen that the explosion very quickly follows the application of the light, so that these guns may be fired at a great distance from a light-house or fog-signal station—a gas gun might be thus half a mile long. If the shots are required to succeed each other rapidly any number of charges may be got ready and successively used. I will now fire the gun which I have loaded.

The gun which you have heard, being simply a piece of tubing, two inches bore by six feet long, has but a feeble sound. The experimental gas guns at Howth Bailey are tubes about eighteen inches bore by nine feet long, and are, as you may suppose, of enormously greater power. The sound of the Bailey gas gun is about equal to that of an eighteen pounder cannon, and the cost of each shot of gas is about the same as that of each charge of gunpowder for the cannon.

GAS SIREN.

One of the most important fog-signals with which we are acquainted, if not the most important, is the American Siren. It has been well-described by Dr. Tyndall, Sir William Thomson, and Sir Richard Collinson, and I only refer to it for the purpose of pointing out that the value of this useful instrument is much increased by its being driven by gas. With gas, at a lighthouse, we are able to set up a most convenient motive-power, requiring neither furnace, boiler, nor stoker, and capable of instant application. The gas engine is by far the best means of driving a siren, chiefly because it may be put into motion in a moment, by the mere application of a match. The advantage of this instantaneous evocation of power can hardly be over-estimated in these days of rapid steam navigation. It is of the utmost importance that, in foggy weather, we should be able to put a powerful sound-signal into full blast at a moment's notice, and this is what can be done with a gas-driven siren. Shipwrecks may take place while we are waiting for the heating of steam boilers, or hot-air engines; and if, as I believe is sometimes done, the furnaces are kept always alight, great waste of fuel is of course involved.

One of these gas sirens has been in operation for some years at Howth Bailey Lighthouse. As an example of the efficiency of this plan of working it, I may mention that on one occasion last year it was sounded for 56 consecutive hours.* The siren at that important station has given great satisfaction to sailors passing near it in fogs, but I may add intense disgust to the residents on the Kingstown shore, six miles distant, where its unceasing wail is not conducive to sound slumber. Right minded people, however, rather enjoy this discomfort for the sake of the mariner. There are, I am confident, some such philantrophists in the world, and among them, I have no doubt, are included the audience whom I have now had the pleasure of addressing.

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* The great advantage which I claim for this method of working the siren, above all other forms of the instrument with which I am acquainted, consists in this, that from the compactness and simplicity of the arrangements by which it is driven, and from the fact that it is not necessary it should be united, by belt or otherwise, with any motive power, it can be sounded at the water's edge or on outlying rock, or at any position far distant from the station at which the steam boiler or compressed air receiver is situated.

CONCLUSION.

In conclusion, I would say that these gas fog signals are important accessories to the gas system, rendering it more complete and lessening its expense; but it is respecting gas as an *illuminant* for lighthouses that we are more immediately concerned this evening, and it is to that subject that the principal part of this paper has been devoted. I believe, and have endeavored to prove, that gas compares favorably with any other illuminant which has been introduced, having, besides its greater illuminating power and moderate cost, "a flexibility, handiness, distinctiveness, and power of variability to meet the changes of the weather," by which it will maintain its superiority over the present oil system. These are not my words; they are those of the highest living authority on lighthouse lights; and as he has again and again, after most painstaking investigations, pronounced in favor of gas, and as his opinions have been corroborated by other thoroughly competent scientific persons (Sir William Thomson, F.R.S., Sir Richard Collinson, Sir Leopold McClintock, F.R.S., etc.), and borne out by the unanimous testimony of sailors navigating the seas where gas is used, it seems only reasonable, as the safety, nay the lives of mariners are at stake, to say nothing of the incalculable amount of property which they carry for us in their ships, that *all* our sailors in *all* our seas should have the advantages which gas-lighted lighthouses can give them.

APPENDIX.

MEMORANDUM OF ANNUAL COSTS OF GAS AND OIL (FROM PARLIAMENTARY PAPER.)

No. 1.—*Paraffin Oil.*

	£	s.	d.
Six-wick lamp, burning three outer wicks only, costs 8s. 8d. per night, for 305 nights (clear weather), say	132	5	0
Six-wick lamp at full power (foggy weather) costs 11s. 10d. per night, for 60 nights, say	35	12	0
Total per annum	£167	17	0

Maximum illuminating power, 722 candles.

No. 2.—*Triform Gas Light.*

	£	s.	d.
One 28-jet burner costs 6s. 8½d. per night, for 305 nights say	102	6	0
Three 28-jet burners cost £1 0s. 2d. per night, for 60 nights, say	60	10	0
Total per annum	£162	16	0

Maximum illuminating power, 1,288 candles.

Cost of paraffin greater than gas by £5 1s.

Illuminating power of gas greater than that of paraffin by 566 candles.

No. 3.—*Also Triform Light.*

	£	s.	d.
One 28-jet burner for 305 nights	102	6	0
Three 48-jet burners cost £1 16s. 8d. per night, for 60 nights, say	110	0	0
Total per annum	£212	6	0

Maximum illuminating power, 2,496 candles.

Cost of paraffin less than gas by £44 9s.

Illuminating power of gas greater than that of paraffin by 1,774 candles.

Note.—These figures as to paraffin are taken from the Trinity House Table, Parliamentary Paper C. 1,151, 1875, p. 64; but in this calculation the price of paraffin is reduced to that now paid by the Commissioners of Irish Lights, and instead of taking one-half for the consumption of paraffin in clear weather, the actual consumption of the three outside wicks, which are turned down in clear weather. The consumption of the three outside wicks is much more than half, they being so much greater in circumference. The figures as to gas are also taken from same Parliamentary Paper, page 44.

Table showing the Comparative Annual Cost of Paraffin and Gas, taking into account the Maximum Illuminating Power in each case.

Annual cost of producing an illuminating power of 100 candles:

	£	s.	d.
With 6-wick paraffin lamp, burning three wicks for 305 nights and six wicks (full power) for 60 nights	23	5	0
With triform gas, 28-jet burner for 305 nights, and two other 28-jet burners for 60 nights	12	12	9
With triform gas, 28-jet burner, for 305 nights, and three 48-jet burners for 60 nights	8	10	1
With triform gas, 28-jet burner for 305 nights, and three 68-jet burners for 60 nights	7	6	9
With triform gas, 28-jet burner for 305 nights, and three 88-jet burners for 60 nights	5	8	6
With triform gas, 28-jet burner for 305 nights, and three 108-jet burners for 60 nights	5	6	8

Or reduced to a unit of *one* candle power.

Annual cost of producing an illuminating power of *one* candle—

	£	s.	d.
With paraffine burned as above	0	4	8
With triform gas as above, 28-jet burner	0	2	6
" " 48-jet "	0	1	8
" " 68-jet "	0	1	5
" " 88-jet "	0	1	8
" " 108-jet "	0	1	0

DISCUSSION.

The Chairman said this was a subject in which he had taken great interest for some years, and he must say that the deviser of the gas system of illumination for lighthouses had that evening given a most striking proof of his energy and ability. He had dwelt upon the handiness and flexibility, or, as Sir William Thomson called it, the plasticity of gas, which was a very important point; for, as every one connected with seafaring matters knew, at the present time, when lights were being so multiplied, it was very essential to be able to distinguish one light from another; and gas lent itself to this very readily, if not better than any other possible system. Mr. Wigham began by attacking the problem as to the best form of burner, and the maximum amount of light to be got from burners, and adopted a form which he supposed to be the best; then he went on in a manner which was highly ingenious from small burners of 28 jets, about equal to a 4-wick lamp (indeed, it was said on the diagram to be superior, being 429 candles as compared with 328, but he doubted whether that represented the most improved form of Trinity 4-wick lamp), from that he advanced to 48 jets, and then, by successive steps, to 68, 88, and 108. He had seen these lamps shining in various places on the coast, and they had given him great delight, being the most powerful flames he had seen. Happily, through healthy competition, the oil system was receiving great development in this country, and by-and-by, probably Mr. Wigham would have a hard conflict with oil lamps. He would be put on his mettle to prove whether his burners were superior to oil in its latest stage of development. There could, however, be no doubt that he had produced not only burners of unparalleled power, but at the same time of unparalleled pliancy and capability to confer distinctiveness on lighthouse lights. He had gone still further, and carried out what he believed was substantially his invention, of superposing the central belts of the lenses one over the other, so as to multiply the light to an extraordinary extent. He had the pleasure of seeing the Galley Head light, and he did not think there could be two opinions about it, that it was the finest flame light which had yet been established, either in this or in any other country. On the whole, the public, and mariners especially, had reason to congratulate themselves that a fresh mind had struck into this subject, which would have a good effect in two ways; first by contributing these splendid lights, and in another way by stimulating those in favor of oil to push their experiments to the utmost.

Mr. J. B. Redman said the author of the paper had given a most graphic description of the various improvements in lighthouse illumination, and he took it that no man living had done more in the application of gas to this purpose. In 1843, he (Mr. Redman) published a pamphlet on the lighthouse system of Great Britain, in which he was then obliged to say with reference to gas, "Coal gas, from the large quantity of fuel required for its production, and the consequent cost of its transport, and also the uncertainty entertained as to the safety of the light, had not been adopted except in a few harbor lights, and even then, in some cases, it has been abandoned." In 1877, however, when lecturing to a class of students in military engineering at Chatham, he was able to refer to Mr. Wigham's gas apparatus at Wicklow Head Lighthouse, as equal to five different degrees of power, and saying that it was so arranged that an ordinary oil lamp could be substituted for it in a moment, showing that even at that time the safety of gas as an illuminant was not thoroughly recognized. But since 1863, at the Howth Bailey Lighthouse, where gas was first used, such substitution had never been required. It was also shown that the results were higher than from oil, prior to Mr. Douglass's recent improvements, which possibly the Chairman had referred to. Mr. Douglass had now produced oil lamps with concentric rings, which would burn mineral or vegetable oil, and from which he got a very high illuminating power. There was also the American Doty lamp, which was similar in principle. The triform arrangement had been found at first to give only twice the illuminating power, with three times the consumption of gas, owing to the loss of light at top and bottom, but he believed that had been satisfactorily got over. It occurred to him that the very beautiful lamps of Mr. Siemens might be applied to the lanterns of lighthouses.

The Secretary (Mr. H. Trueman Wood) said he could not pretend to any practical knowledge of lighthouse apparatus, but some time ago, in connection with investigations at the Patent-office, he had had occasion to become

acquainted with the principles of lighthouse illumination, and he might perhaps offer a remark or two which might have the effect of eliciting some further information from Mr. Wigham. In the great battle which was now going on between gas and electricity there were few fields of more importance than this of lighthouse illumination, and any information on this subject would be most useful. There must of course be many places where nothing but oil could be used: and he supposed even Mr. Wigham would admit that where the very greatest light was required they would have to rely on the electric light; but in the great majority of cases the field was fairly open for gas or oil, and any further information on the comparative advantages of these two illuminants would be of great service. He would ask whether there was really any great saving by using gas where the dioptric system was adopted, because it was tolerably certain that with a good dioptric system there was no loss of light at all; it was all concentrated into those parts of the horizon on which the flash came, the light which would fall on the dark parts being turned aside and added to the illumination where it was required. This being so, and all the light which was produced being utilized, he did not quite see where the saving was to come from, unless it were that a much simpler apparatus could be used, which lead to a saving in the initial cost of the apparatus itself. If they were ever to have anything like the system advocated by Sir William Thomson in a paper read last year: by which each lighthouse would flash out its own name, there were obvious advantages in the use of an illuminant which could be turned up and down: and caused to give flashes of any length or character which might be required, instead of a costly apparatus such as was required when it alone was relied upon for giving flashes of different lengths. With regard to the comparative penetrating powers of gas and electricity in fogs, it was pretty well admitted that in a thick London fog electricity had very little chance with gas. The yellow rays of the gas passed much more readily through the yellow fog than the more refrangible rays of the electric light; but was this the case with the whiter fogs which prevailed at sea? He did not like to say much about the vexed question of ex focal light, but to an outsider it seemed strange that engineers should devote all their powers to concentrating all the light they possibly could into a very small arc—the arc subtended by a line drawn from the horizon to a point comparatively near the base of a lighthouse of considerable height was not more than 17 minutes—and yet be grateful that some of it escaped from the apparatus, and was distributed to the ground and the sky. If that were really wanted would it not be better to construct the apparatus so that some of the light would be purposely directed to those points, and not to trust to chance for such rays as were scattered abroad, where, no doubt, they had their use, but where they were much less required than on the sea itself.

Mr. Liggins remarked that now that our ships had so greatly increased in size, and the duration of voyages was so much accelerated, while greater punctuality was insisted on by passengers, it became of more importance than ever that the mariner should be guided to a safe destination by the most perfect light that the knowledge of the present day could devise. He had never listened to a paper with more satisfaction than the present one. He had not happened to be on the Irish coast for some years, and, therefore, had not seen the lights referred to; but until now he had been of the opinion, from some observations, that the most perfect lights on our coast were the two on the South Foreland. He crossed not long ago from France, on rather a misty day, as it was getting towards dusk, and he was struck with the extreme penetrative power of these two magnificent lights; and on looking back towards France, he saw at Cape Grisnez a similar specimen of the penetrative power of the electric light. But he confessed after to-night's exhibition he should go away satisfied that he had still much to learn with regard to lighthouses and lightships. He should like to ask, however, whether the great concentration of gas lights in so small a space would not produce so much heat as rapidly to destroy the burners, because if a burner or two were to give way each night, it would disarrange the light, and cause irregularity? Of course this was a matter of detail, which might be got over by experiment. He was quite sure from what he had heard that this matter was as yet in its infancy.

Mr. Wigham, in reply, said the figures as to the power of the oil lamps were taken from the trials of the Haisborough lamps, which were then considered the improved Trinity-house lamps; and they were certainly a great improvement on those which had been used for many years before. There may have been subsequent improvements, and he believed there had, and that still greater improvements were in contemplation, but those were the Haisborough lamps about which a Parliamentary paper had been issued, containing the figures as he had given them. As to oil lamps being made to beat gas, he should enter into the fight with the greatest possible pleasure, because he was perfectly satisfied that if an oil light were made to-morrow, having all the power and all the advantages which gas lights had, a gas light would be made to beat it next day. He saw so much capacity of development in the future of gas, that he did not think the battle could be left long in dispute. It was quite true, as Mr. Redman stated, that when gas was first used in lighthouses, engineers were so timid about it that before they allowed it to be applied they required that, at a moment's notice, the gas burner should be replaced by an oil lamp. That was rather a difficult thing to do, because of the adjustment of the oil lamp in its exact focal place, and because the time occupied in screwing the joints on and off was likely to be very considerable; but a plan was devised similar to that by which the gas light was increased, the oil lamp being made to drop into a cup of mercury, so that the oil would flow up immediately, without any screwing or adjustment. But so certain and continuous had been the supply of gas from that day to this, that it had never been applied. Reference had been made to the loss of light from the top and bottom prisms; and it had been estimated that the light from these prisms was equal to 30 per cent. of that from the whole apparatus. He had often tried the experiment of shutting off the top and bottom, or shutting out the middle, and looking at the light from a distance, and it did not appear to him that the proportion was so great; but even if it were, he thought it was better to have three times 70, *i.e.*, 210, than 100; and for that reason he devised the triform light, cutting off the top and bottom altogether. The Siemens burners were certainly very beautiful, and he had been much attracted by them. They would form very suitable burners for lighthouses, only that he did not quite see that they were capable of being increased in power to meet the various states of the atmosphere. The products of combustion were drawn down a central tube, and he did not see how the power could be adjusted, at any rate so easily as in a burner which had not this central flue. Again, a considerable portion of the light was sucked down this central tube, and of course lost for all illuminating purposes, though it might be compensated for in greater intensity in the rest of the flame. He also had a doubt whether for a lenticular light, which required a focus, it was not better to have that focus in a flame than to have a solid cylinder as in the Siemens lamp. He would not use the electric light at all for lighthouses, but he did not go at length into that subject, as it had been thoroughly treated at York by the British Association. The evidence was to the effect that whether it was from the color of the light, or whether it was from the comparatively small point from which the light emanated, where it had been tried it had been found wanting; and, after all, practical tests were the great thing in matters of this kind. He had ventured to say in the paper that the Government should try the electric light against some of these gas lamps, or against the largest oil lamp they could get. If the electric light were better than gas, by all means use it; but he had great doubts about it. He recollected trying it very carefully on the clock tower at Westminster, the Commissioners of Works at that time being very anxious about it. He had a very powerful apparatus made by Messrs. Chance, in which there was an electric light fed by a large Gramme machine worked by a steam engine in the basement, and it was compared with three 68 jet burners such as he had shown. When he was in Palace-yard, he thought he was completely beaten; the electric light lit up the whole yard, and the gas looked like a tallow candle; but when they went to Primrose-hill to judge of it, they found that when the weather got to a certain degree of density, the electric light got smaller and smaller until it went completely out, and the gas light still shone through. There were some fogs which put the gas light out also; but when the fog cleared away the gas light shown out first, and the electric light came in view a good while after. So that, however superior the electric light might be for some purposes, for lighthouses and for penetrating fog he feared it was not the best. He did not quite know what saving Mr. Wood referred to in the dioptric system; but what he alluded to was the actual saving from the extinction of the gas. Sir William Thomson and the Morse system had been referred to; and he must say he had always had the greatest sympathy with his views about that—especially those views which he had recently modified. He had always thought it would be difficult to get sailors to go into the minutiæ of the Morse system; but at the same time, in advocating a system of flashing lights instead of fixed lights, because of their greater power, and that the flashes should be much more frequent—one minute, or even less, instead of two—his remarks were deserving of the greatest consideration. With regard to the ex-focal light, they ought to be very grateful to optical engineers, who had taken so much pains to give as much focal light as possible; he would like the greatest possible amount of light in the focus; but he would also like some light out of the focus, and he believed that in many cases it was more useful to have a large amount of ex focal light than to have a very intense focal light, because the focal light was confined to a very small limit, while the ex focal light might have a very wide range, extending up into the thinner mists, above those which might possibly obscure the one direct beam. It was not, perhaps, necessary to say anything more about the electric lights at the South Foreland; but he had heard complaints of their not always being visible in foggy weather; in some cases the lights on the Admiralty pier at Dover were visible, when they were not. Heat was not destructive to his burners at all. The top of the burner was a common fishtail, which cost, perhaps, ¼d., and could be

replaced very easily; and as to the lenses, great care was taken, before gas was allowed to be used, to prove that heat would have no injurious effect upon them.

The Chairman then proposed a vote of thanks to Mr. Wigham, which was carried unanimously, and the proceedings terminated.

The Fulton Municipal Gas Company of Brooklyn.

The Fulton Municipal Gas Company of Brooklyn obtained a franchise from the Common Council of that city about three years ago to lay their pipes and furnish gas to consumers. They claim that they furnish a brighter and cheaper light than any of the old corporations, by the use of naphtha or the refuse of petroleum oil, which is blended with coal. Within the past few days the Company has passed under control of the Standard Oil Company, Messrs. B. Brewster, H. H. Rogers, W. Rockafeller, and H. R. Bishop having become members of the Board of Directors of the gas corporation named. The other directors are H. M. Benedict, president; General James Jourdan, vice president; and E. C. Benedict. The capital stock, it was announced yesterday, has been increased to $3,000,000, being an addition of $1,800,000 to the original amount. It is also proposed to extend the pipes throughout the city. The inevitable result will be, some members of the Company claim, that the old gas companies must either sell out or combine with them. The overcharged consumers may possibly profit by a gas war.—N. Y. *Herald*, April 15.

Gas Industry.--Notes and Observations.

By Geo. Shepard Page.

CREOSOTING.

John Bethell, of London, Eng., has been recognized as the original inventor of the process of wood preservation by the use of creosote oil—the heavy oil of coal tar. This has been due to the fact that a patent was granted to him in 1838. In truth, the real discoverer of the only absolute method of preserving wood from either wet or dry rot, or destruction by the teredo, white ant, or other enemy of wood, was Henry Potter Burt, head of the firm of Burt, Boulton & Haywood, of London. Recent inquiries as to the origin of this invention, from the most undoubted authorities, have resulted in the following data.

Mr. Burt was a practical engineer, and associated in business with Mr. Bethell, a solicitor by profession. The former supplied the technical knowledge of machinery and engineering materials which was necessary to render the process effective. This occurred in the year 1838, also made notable by the patent granted Francis Burnett for his process for treating wood by injecting chloride of zinc into its pores, for which he was knighted by Queen Victoria.

Mr. Burt founded the house of Burt, Boulton & Haywood, now widely known as the most extensive distillers of coal tar, as well as the largest establishment engaged in creosoting in the world. They have eighteen wood preserving works in the different countries in Europe, from which creosoted railway ties and other timber are shipped to all parts of the world.

Many other processes have been patented in Europe and in this country, most of them employing metallic salts. In Europe nearly all have been abandoned, and the best engineering authorities agree that the only system which has a recorded life of ten years, for wood used in railway, telegraph, dock, and bridge construction, is that of creosoting. In our country there is a repetition, with slight variations, of the numerous expensive and disappointing use of the various salts of zinc, copper, barium, iron, etc. Large amounts of money have been paid by innocent capitalists for so-called "patents" for wood preservation which simply ring the changes on English, French, and German inventions, proved valuless two score years ago. The large amount of money invested in various schemes for developing processes of wood preservation, illustrate the general belief that ere long some process must be adopted for the treatment of wood, to secure its increased durability.

The conclusions of some of America's ablest engineers will be of interest. Mr. T. E. Sickles, Consulting Engineer of the Union Pacific Railroad, during a recent journey stated to the writer that he was sent on a special mission to Europe to investigate this subject, and spent several months abroad thoroughly examining into the results of the various processes of treatment. His report was very exhaustive, and fully confirmed the statements I have made. Creosoting was the only process which had enabled wood to survive the inevitable effects of exposure to the elements.

Three years ago the American Society of Civil Engineers, through Mr. John Bogart, Secretary, addressed communications to a large number of engineers in charge of European railways, as to the process employed by them for wood preservation, and the increased length of life resulting therefrom. The reports received indicated that creosoted wood was employed almost universally, and that cross ties and timbers were in many cases sound and in use after 25 years of service.

In an interview with Capt. J. B. Eads, during which the subject was discussed, he affirmed his belief in creosoting as the only reliable process. A few days since, in conference with Maj.-Gen. Q. A. Gillmore, President of the Mississippi River Improvement Commission, he gave unequivocal testimony to the value of this mode of treatment. Mr. G. Bouscaren, Consulting Engineer of the Cincinnati Southern and New Orleans and North Eastern Railroads, writes me that the timber for the eighteen mile trestle across Lake Pontchartrain is to be creosoted, this process having been adopted after most thorough investigation. Mr. M. G. Howe, Chief Engineer of Houston and Central R.R., adopted creosoting five years ago, and a very large amount of timber has been treated at the extensive works at Houston.

As another proof of the importance of this matter, the American Society of Civil Engineers have appointed a special committee of eminent engineers, of which Mr. O. Chanute, Chief Engineer of the Erie Railway, is chairman, to investigate and report upon this subject, and it is expected that they will make a report at the annual convention of the Society in Washington, on May 16; and it is understood that the evidence in favor of creosoting is most positive and convincing.

I could multiply confirmatory illustrations, but these will suffice to convince every unprejudiced person that the creosoting system meets every requisite, and will in due time be as generally adopted in this country as it has been in Europe.

Award of Contracts for Public Lighting in N. Y. City.

The Gas Commission, which consists of Mayor Grace, Comptroller Campbell, and Commissioner Thompson, of the Department of Public Works, yesterday awarded the contracts for lighting the city for the year ending April 30, 1883. The contract made last year with the Brush Electric Light Company, for lighting Broadway from Fourteenth to Thirty-fourth street, Fourteenth street from Fourth to Fifth avenue, Thirty-fourth street from Broadway to Fifth avenue, and Union and Madison squares, was continued for the ensuing year. Last year the Brush Company were paid 33¼ cents per lamp per night, but this year a demand was made for 70 cents per lamp per night. While continuing the old contract, the Gas Commission refused to extend the Brush Company's territory, because of the greatly increased expense.

The United States Electric Light Company for the first time received the contract to light Battery Park, City Hall Park, Broadway from Canal to Fourteenth street, Washington Park, and Fifth avenue from Washington Park to Fourteenth street. The price agreed upon is 70 cents per lamp per night.

Contracts were awarded to the various gas companies as follows:

New York Gas Company, the district south of Grand street, at $17.50 a lamp per year; Mannattan Gas Company, the district bounded by Grand and Thirty-fourth street, at $17.50 per lamp per year; Mutual Gas Company, certain streets in the district between Thirty-fourth and Seventy-ninth streets, and the parks south of Thirty-fourth street, with the exception of Madison and Union squares, at $17.50 per lamp; Metropolitan Gas Company, the remaining streets in the district between Thirty-fourth and Seventy-fourth streets, at $17.50 per lamp; Harlem Gas Company, the district north of Seventy-ninth street, south of Spuyten Duyvil Creek and the Harlem River, at $19.50 per lamp; Central Gas Company, the Twenty-third Ward, at $29 per lamp; Northern Gas Company, that portion of the Twenty-fourth Ward known as West Farms, at $32 per year; Yonkers Gas Company, the remaining portion of the Twenty-fourth Ward, at $30 per year.—New York *Herald*, April 18.

The Electric Light.—Its Uses and Abuses.

The parties who have undertaken the task of furnishing the electric light in this city suffer a great many inconveniences. In the first place, it is asserted that the engine used at the company's headquarters is not of sufficient power to furnish the necessary light, an annoyance greatly complained of by customers. Very often it transpires that the light is entirely extinguished, and the only alternative left the customers is to use the gas—an expense entirely unlooked for. It often happens that light is not furnished for four or five nights during the month, but when the monthly bills arrive it is found that no reduction has been made for the nights on which no light had been furnished, a fact which causes a deal of trouble to both the consumers and the company. Winne & Co., being considerably bothered by the extinguishing of the light on occasions when it was most needed, notified the company to take out their lamps, as it was the intention of the firm to give up using the electric light. The company paid no attention to

the notification, whereupon the wires in Winne & Co.'s store were cut by the firm, thus shutting off the supply. Other merchants who have been placed to a great deal of trouble by the antics of the electric light threaten to follow the example of Winne & Co., and it looks as if the electric light company will have a hard road to travel before the arrangements will work to the satisfaction of all its customers.—Troy *Observer*, April 17.

Twenty-Sixth Annual Report of the St Catharines and Welland Canal Gas Light Company.

The Directors have pleasure in submitting their Annual Report for the year ending February 28th, 1882, with the usual Statements.

The quantity of gas manufactured was 11,100,200 feet, being an increase of 967,400 over the previous year.

The gross earnings were $26,890.16, as compared to $24,435.14, being an increase of $2,455.02. The expenses for the year were $14,497.57. as against $13,811.36, or an increase of $686.21.

The net receipts compare most favorably, being $12,392.59, as against $10,623.78, or a gain of $1,768.81.

During the year two dividends of five and four per cent., amounting to $9,000, have been paid, and the balance of earnings, $3,392.59, carried to Profit and Loss Account, leaving at the credit of that account, $23,020.97.

Owing to the near completion of the new Welland Canal, a notice has been received from the Government, informing the Company that the use of gas on the old canal will be discontinued after the close of navigation the present year. Since then your directors have concluded a contract with the Government for lighting the new canal with gas for a period of 21 years, at a fixed sum of $10,000 yearly for 108 lights of forty-candle power each, which will necessitate a large outlay. In view of this the directors deemed it prudent to reduce the last half-year's dividend to four per cent., and a circular has been addressed to you that at the general meeting the advisability of increasing the capital stock would be considered.

The accounts of the year have undergone the usual examination, and the Auditor's Report to that effect will be found herewith.

F. J. Timmons, *Secretary.* Thos. R. Merrit, *President.*

St. Catharines, April 5th, 1882.

General Expense Account for Year Ending February 28, 1882.

Coal used		$6,629 01
Lime used		165 40
Stokers and lamplighters, wages		2,759 99
Taxes	$617 40	
Insurance	170 00	
Office and Wharf Rent	128 00	
Auditor's Fees	30 00	
Printing, Stationery and other contingencies	86 91	
		1,032 31
General Repairs	1,237 41	
Wear and tear of Meters	263 45	
		1,500 86
Salaries		2,410 00
Charged to Profit and Loss		$14,497 57

Profit and Loss Account.

1881.		
March 1—By Balance at Credit		$19,628 38
1882.		
March 1—By Receipts from Gas	$24,754 96	
By " " Coke and tar	1,660 05	
By " " Interest	475 15	
		26,890 16
		$46,518 54
1881.		
Sept. 30—To paid Dividend No. 41	5,000 00	
1882.		
March 2—To paid Dividend No. 42	4,000 00	
To paid General Expenses	14,497 57	
		23,497 57
Leaving Balance at Credit		$23,020 97

Gas Works at Cairo, Ills., Damaged by a Tornado.

A fearful tornado passed over Cairo, Illinois, about 5 o'clock, P.M., on April 22d, coming from a westerly direction. Although of but few seconds duration, it blew down the Colored Methodist Church, and four other buildings, unroofed ten or fifteen other buildings, and blew over five loaded freight cars on the Wabash Railroad. It also did considerable damage to the city gas works by overturning the gasometer; also completely destroying telegraph and telephone communication. No lives were lost, but two or three persons were slightly hurt. The tornado was accompanied by a heavy hailstorm, which did considerable damage to windows and skylights.

Electric Light at Newport, R. I.

A taxpayers' vote upon the following proposition was taken on April 19th, and resulted in its adoption by a majority of 205 in a total vote of 939.

"Shall the City Council be authorized to light Equality Park, Washington Square, Touro Park, and Bellevue Avenue with the electric light at a cost not to exceed six thousand dollars per annum?"

No definite statement is here made of the number of lights or the price per lamp.

Electric Light at Lafayette, Ind.

The Cincinnati *Commercial*, of April 17th, says that the Brush company have put their lights in operation in the above-named city. They have but one mast and five lamps. The city contracted for two years. The light went into operation on the evening of the 14th, and caused quite an excitement among the people of the city. There is a wide diversity of opinion as to whether or not the light will prove a success sufficient to do away with gas.

Correspondence

[The Journal is not responsible for the opinions expressed by correspondents.]

Relation of Holder Capacity to Make.

Philadelphia, April 13th, 1881.

To the Editor American Gas Light Journal:

Noticing communication of "F," in yours of April 3d, I send a solution of the ratio of holder capacity to other requirements of a works, from the gas constructor's point of view—that is, the rules for proportioning the holder of a newly designed works.

Having ascertained from other data, based upon local demands, what will become a proper supply to meet a day's, or hour's, requirement of the proposed new works at Christmas, or on the average, the ratios become:

	Christmas capacity.	Holder.	9 to 10 consump.	Max. hourly production.	Av'ge hourly production.
Christmas capacity per diem..	1	2	7.2	24	53.333
Holder capacity in full.....	½	1	3.6	12	26.667
9 to 10 P.M or 8 to 9 consump.	0.138	0.276	1	3.33	7.407
Maximum hourly production..	0.042	0.084	0.3	1	2.222
Average hourly production....	0.019	0.037	0.135	0.45	1

The 24 hours at Christmas may be taken to require as follows: 4 to 5 p.m., 0.15; 5 to 6 p.m., 0.5; 6 to 7 p.m., 0.8; 7 to 8 p.m., 0.9; 8 to 9 p.m., 1.0; 9 to 10 p.m., 1.0; 11 to 12 m., 0.8; 12 to 1 m., 0.6; 1 to 2 a.m., 0.15; 2 to 6 a.m., 0.4; 6 a.m. to 4 p.m., 0.5=total 7.3 times the quantity demanded for the hours 8 to 9 or 9 to 10.

The maximum production may be taken at 0.3 the demand of those hours; when the excesses of quantity demanded become—

—— 5 to 6 p.m., 0.2; 6 to 7 p.m., 0.5; 7 to 8 p.m., 0.6; 8 to 9 p.m., 0.7; 9 to 10 p.m., 0.7; 11 to 12 m., 0.5; 12 to 1 m., 0.3—total=3.6 times the quantity 8 to 9 p.m.

The least daily consump. can be taken as equal to 0.3 Christmas consump.
The av'ge " " " 0.4 to 0.45 "

I should be gratified to have these data discussed.

Respectfully,
Robt. Briggs, C.E.

The Mare Island Pipe Line.

New York, April 25, 1881.

To the Editor American Gas Light Journal:

In the American Gas Light Journal, for March 16th, 1881, was published an account of a submerged pipe, laid without drip-vessel, to connect the works of the Vallejo (Cal.) Gas Light Company with the United States Navy Yard on Mare Island.

It is not necessary to repeat the details of this system, further than to mention that the pipe is 2-inch caliber, of galvanized wrought iron, and laid across the bottom of a tidal strait 1,400 feet wide, and between 35 and 40 feet deep.

Now, this pipe had passed (from September 1st, 1880, to February 1st, 1882), about 2,850,000 cubic feet of gas, without the least obstruction of the submerged pipe, or one drop of condensed liquid showing in a drip pot located above high-water mark on the Mare Island shore.

Can any of the readers of the Journal explain this?

Jas. R. Smedberg.

THE AMERICAN
GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
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Editor—G. WARREN DRESSER.
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TUESDAY, MAY 2, 1882.

Changes.

Mr. Wm. H. Watts has retired from the position of superintendent of the East St. Louis Gas Light Company, and is succeeded by Mr. G. W. Ewing.

Patents.

253,850. Gas heating apparatus.—S. Darling.
254,198. Automatic gas light extinguisher.—W. Clancy.
254,204. Process of and apparatus for manufacturing gas.—T. B. Fogarty.
254,213. Gas apparatus.—J. Hanlon.
254,243. Device for carbureting gas or air.—D. M. Small.
254,633. Automatic draught regulator for oil and gas stoves.—R. A. Gardner.
254,850. Pipe coupling.—J. C. Telfer.
254,979. Lamp and gas stove.—J. H. Irwin.
255,073. Gas machine.—E. C. Burgess.
255,517. Gas regulator.—G. S. Lacey.
255,524. Electric gas lighter.—A. Mahon and W. J. Green.
255,786. Process of and apparatus for manufacturing gas.—J. W. Hodges.
256,406. Apparatus for making carbureted hydrogen gas.—W. H. Taylor.
256,426. Clamp for extension gas fixtures.—J. F. Brown.
257,701. Combined gas and electric lamp fixture.—E. H. Johnson.
256,741. Gas generating apparatus.—E. B. Reynolds.

REISSUES.

10,056. Process of and apparatus for manufacturing gas for heating and illuminating purposes.—H. Y. Attrill and W. Farmer.
10,070. Gasalier.—J. H. Seaman.
10,071. Gasalier.—J. H. Seaman.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
(with W B Scott & Co.,)
34 PINE STREET, NEW YORK CITY.

MAY 2, 1882.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid.	Asked
Gas Co.'s of N. Y. City.				
Central	$466,000	50	70	75
Harlem	1,800,000	50	94	96
" Bonds	170,000			103
Manhattan	4,000,000	50	230	235
Metropolitan	2,500,000	100	163	167
" Bonds	658,000	..	107	110
Mutual	5,000,000	100	97	99
" Bonds, go'd.	900,000	1000	202	205x
Municipal	1,500,000	100	198	202
" Bonds	750,000		106	110
New York	4,000,000	100	120	125
Northern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	100	103
Citizens	1,200,000	20	63	67
" S. F. Bonds.	320,000	1000	105	109
Fulton Municipal	3,000,000	100	90	55
Peoples	1,000,000	10	35	37
" Bonds	290,000	.	104	107
" "	250,000	...	90	92
Metropolitan	1,000,000	100	50	55
Nassau	1,000,000	25	50	55
" Ctfs.	700,000	1000	93	96
Williamsburgh	1,000,000	50	50	60
" Bonds	1,000,000	...	100	101
Richmond Co., S. I.	300,000	50	70	75
" Bonds	40,000	—	—	—
Out of Town Gas Companies.				
Buffalo Mutual, N.Y	750,000	100	—	75
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	—	—
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.			178	180
Consolidated, Balt.			38	39
Bonds			107	—
East Boston, Mass	220,000	25	122	128
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	140	144
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
Jersey City	750,000	20	155	160
Jacksonville, Ill	120,000	50	100	...
Lewistown Maine	400,000	100	—	100
Laclede St Louis Mo.	1,200,000	100	112	117
Montreal, Canada	2,000,000	100	173	174
New Haven, Conn		25	132	—
Oakland, Cal			32	33
Peoples, Jersey City		...	75	80
" " Bds.				5
Pittsfield, Mass			120	130
Rochester, N. Y.		50	70	80
Wilmington, Del.		50	174	...
Yonkers		50	30	32
St. Louis Missouri	600,000	50	250	254
San Francisco Gas-Co., S. Fr'isco Cal.			68	69
Toledo, Ohio			95	97
Troy, Citizens	600,000	100	—	—
Washington, D. C.	1,500,000	20	185	200
" Scrip	375,000	15	200	206

Sold at auction—50 shares Manhattan at 230½; 65 shares New York at 123ex; 197 Harlem, at 94.

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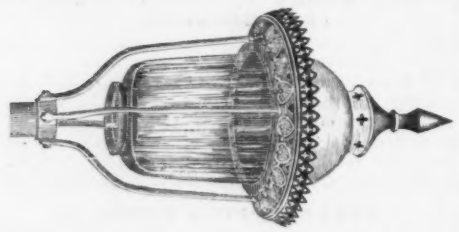

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GAS WORKS, PLACE D'ORLEANS, QUEBEC, March 10, 1882.

GEO. SHEPARD PAGE, ESQ., New York:—I inclose you copies of the Government Inspector's test and certificate, showing that the washer is working well and taking out every particle of ammonia.

D. H. GEGGIE, Secretary and Manager.

"GAS INSPECTOR'S OFFICE, QUEBEC, March 7, 1882.

"I hereby certify that at the request of the Quebec Gas Company I have tested the purity of the gas furnished by the said Company, and after testing such gas in accordance with the provisions of the act to provide for the inspection of gas, I find the quantity of ammonia contained therein is 0.00 in 100 cubic feet thereof.

N. LEVASSEUR, Inspector."

NEWPORT GAS LIGHT CO., NEWPORT, R. I., March 12, 1882.

GEO. SHEBARD PAGE, ESQ.:—I have many letters inquiring about my experience with the "Standard" Washer-Scrubber, and I give only the plain facts of its behavior with us, which is in every respect so creditable to the machine that I can always give it a first-class character to those seeking its help.

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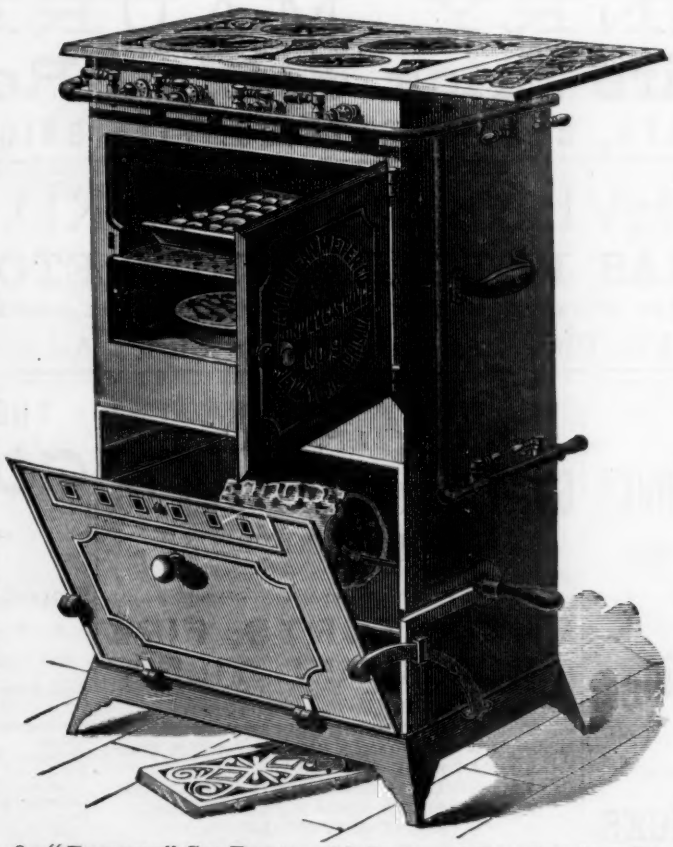

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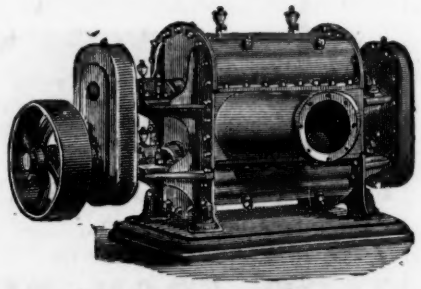

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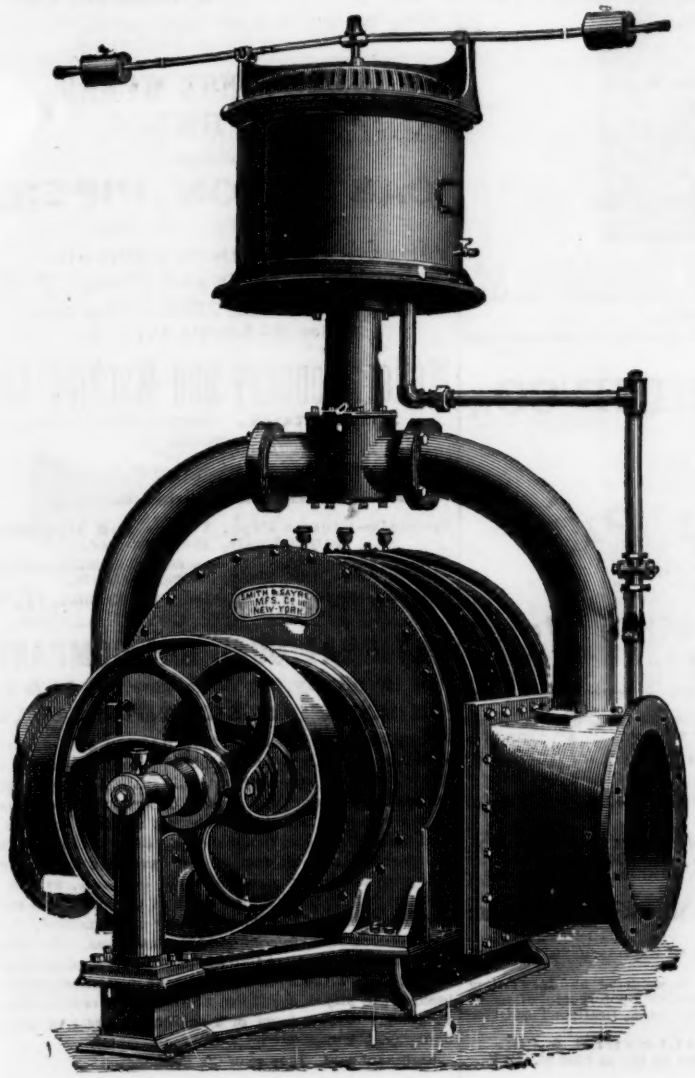

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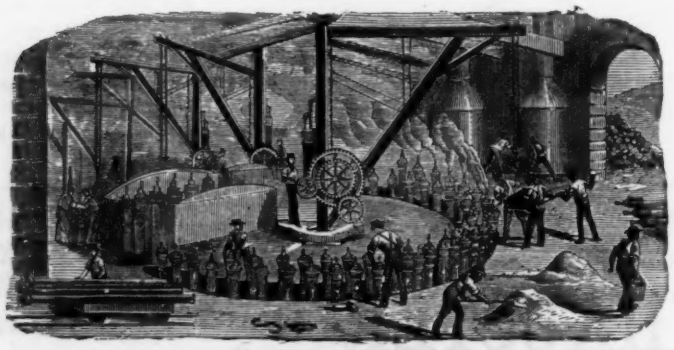

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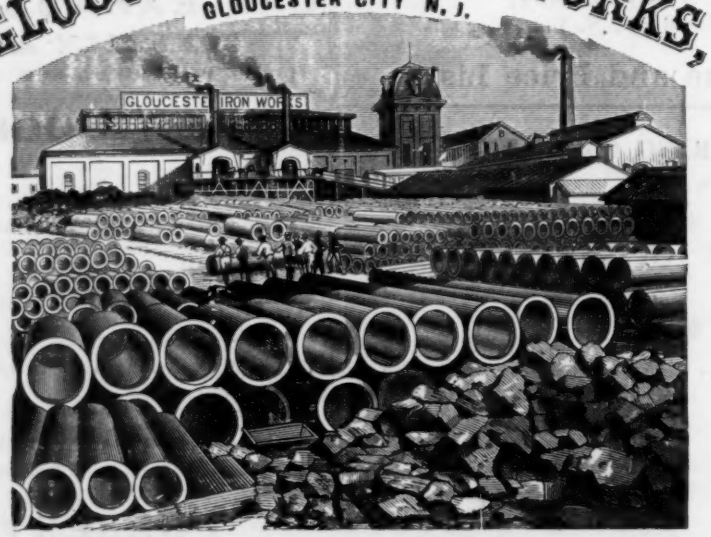

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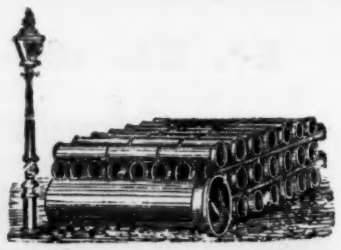

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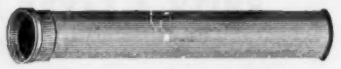

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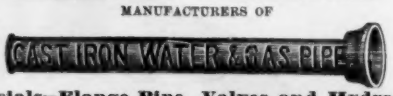

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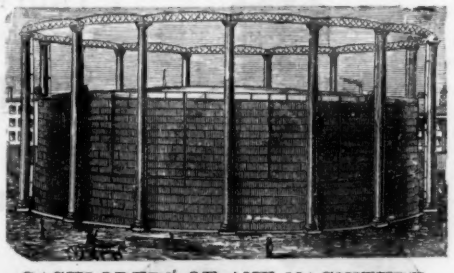

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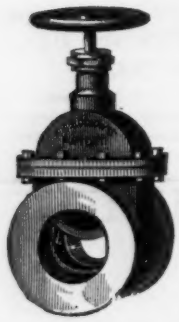

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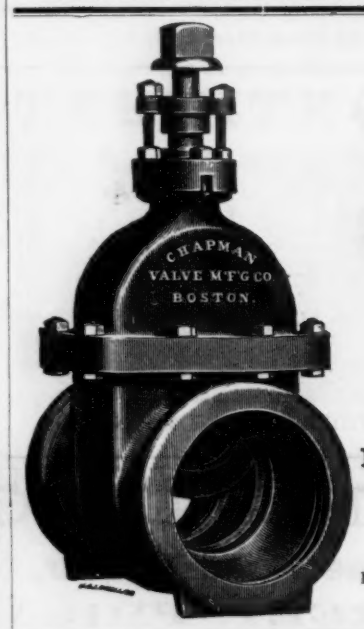

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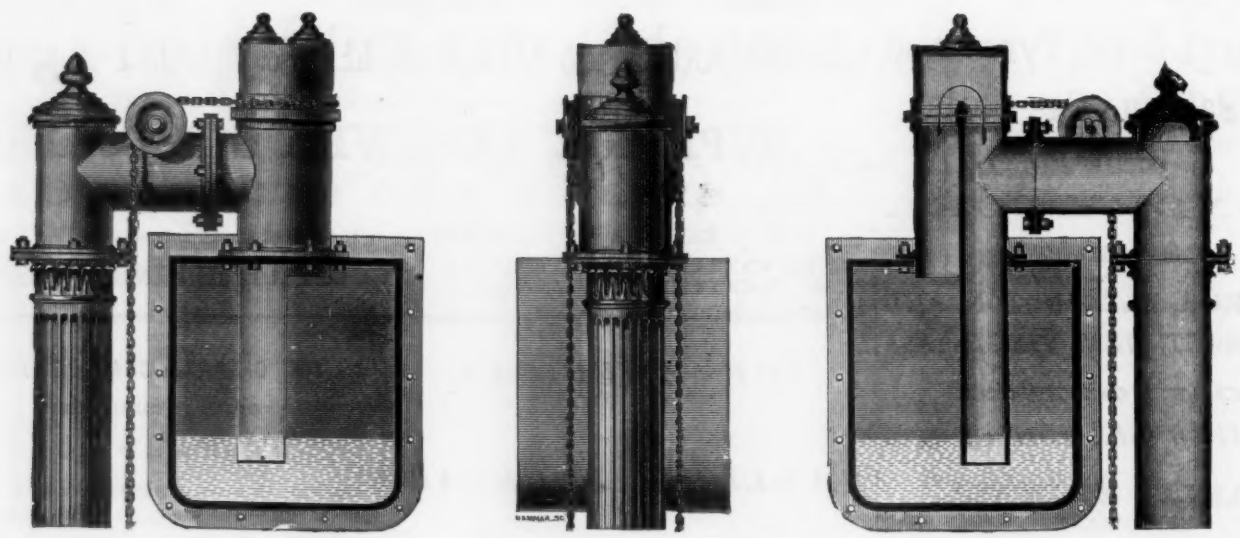

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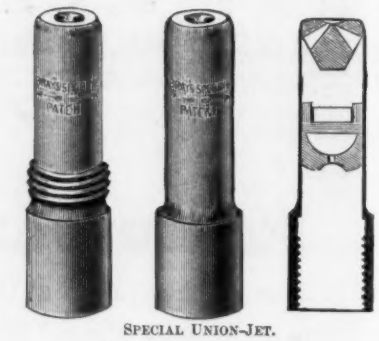

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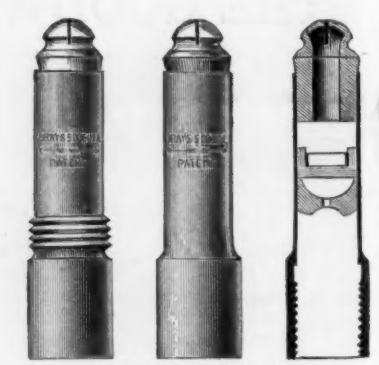

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" " Union Jet No. 7.....	.50	4.84	19.13	19.76	3.95
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" " " No. 5.....	.60	4.14	15.65	18.90	3.78
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